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SPONTANEOUS HEMORRHAGE INTO THE RECTUS MUSCLE: TWO CASE REPORTS AND A REVIEW OF THE LITERATURE

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Hemorrhage into the sheath of the rectus abdominis muscle may produce a clinical picture that mimics an acute intra-abdominal condition. Its presence is rarely suspected and diagnosis is often made only after exploration has been performed. This presentation is to report 2 cases and to review the pertinent findings in this condition.

This lesion has been described since the time of Galen and Hippocrates.[40] It was first reported in the United States by Samuel Richardson of Louisville, Kentucky, in 1857.[53] In 1882, Madyl collected 14 cases.[40] Wohlgemuth[69] was able to present 127 cases from Europe in 1923. Stoeckel[59] in 1901 recorded the first case associated with pregnancy.

There are certain anatomic aspects of the rectus muscle and its blood supply which contribute to the pathogenesis of this condition. In an exhaustive anatomic study of the rectus muscle, Brödel[17] demonstrated several features of the anatomy of the rectus muscle which explains the clinical picture often seen. It was demonstrated that when the rectus muscle contracts, the distal portion, that is between the symphysis pubis and the first tendinous inscription, contracts a greater distance than the other part of the muscle. Also the most distal segment of the muscle is the narrowest, thickest and strongest. It was found that there was a difference in the manner in which the branches of the inferior epigastric artery supplied the distal part of the rectus muscle as compared to the proximal. The deep inferior epigastric artery is more tortuous in the lower portion; also its branches traverse longer distances over the surface before entering the muscle. This arrangement is thought to be a protective mechanism, necessitated by its

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relatively greater length. The distal portion contracts which leaves the extramuscular portion of blood supply more exposed to trauma. Another important anatomic arrangement is the absence, below the semicircular line of Douglas, of those components of the posterior rectus sheath which are derived from the external oblique, internal oblique and transversus muscles. Thus there remains only the transversalis fascia and the peritoneum posterior to the lower portion of the rectus muscle. This muscle, aside from undergoing voluntary contraction while performing such maneuvers as sitting or bending, is also utilized in coughing, vomiting and defecation. Also during labor, the rectus muscle vigorously contracts.

Hemorrhage into the sheath of the rectus muscle can be the result of: (1) rupture of either the superior or inferior deep epigastric artery, (2) rupture of the accompanying vein, (3) rupture of the rectus muscle, (4) rupture of all of the above.[34]

Hemorrhage into the rectus sheath may form a hematoma in the lower portion of the muscle. It is more likely to bulge posteriorly than anteriorly, which makes it difficult to palpate. Hematomas vary greatly in size but may be as large as a football.[69] If hemorrhage into the rectus sheath occurs as a result of rupture of the muscle a clot may not form, but blood may extravasate into the substance of the muscle. It is uncommon for the hematoma resulting from hemorrhage into the rectus sheath to rupture into the peritoneal cavity, however, it does occur in a small number of patients.

Hilgenreiner[29] in 1923 made a classification of hemorrhage into the rectus sheath which is logical and clinically useful.

Group I. Due to trauma:
- A. Direct trauma to the abdominal wall
- B. Indirect force, usually occurring in healthy young men.

Group II. Those in which there may be a small amount of trauma, but in which the muscles are weakened:
- A. In some serious infections such as tetanus, typhoid, typhus or influenza; the presence of some local muscular change is presumed
- B. In pregnancy, labor or the puerperium
- C. In elderly women, most of whom have had one or more pregnancies.

The occurrence of this condition associated with infectious disease is related to two factors. One, the so-called hyaline degeneration of Zenker,[70] which has been reported as occurring in the substance of the rectus muscle. Two, in numerous infections with a severe cough, much stress is placed on the rectus muscle sometimes resulting in its rupture with simultaneous injury to its blood supply. The presence of cough and of the specific degenerative lesions as sometimes found in influenza seems logical to account for the numerous cases reported during the pandemic of influenza in 1917–1918.[3]

A review of 107 cases in the literature is made in this report. A tabulation of the characteristics of this condition revealed the following statistics which may be significant.

The average age of the occurrence in both sexes was 46 years. In males the average age was 40 years and in females 48.6 years. It is thought that the presence of this condition secondary to trauma in young males account for the lower average in this sex. The fact that this condition appears more commonly after middle life is due to lack of exercise and subsequent decreased muscle tone with an inadequate protection to the blood supply. In some instances atherosclerosis or other degenerative diseases have been noted as being quite severe.[53, 59]

There is no proved reason why a discrepancy in racial occurrence exists. The white race constituted 96.2 per cent of the cases studied. This marked difference is probably of less significance than it appears.

This condition is more than twice as common in females as in males. Several factors may be implicated to account for this difference; namely, pregnancy and the higher incidence of obesity with its resultant lack of muscle tone in females of middle age and older. Pregnancy was associated in 23.4 per cent of the females in this series. In most instances the difficulty occurred in the third trimester. Over 60 per cent of the pregnant patients had an associated cough and an acute respiratory infection. Trauma was implicated in only two instances associated with pregnancy.

Hemorrhage into the rectus sheath is most commonly found in the lower portion of the rectus muscle with a marked tendency to occur on the right side. In over 50 per cent of the patients the hemorrhage was in the right lower quadrant. The left lower quadrant was the site in 30 per cent. Hemorrhage occurring in the upper quadrants was divided equally between both sides. These data substantiate the significance of the anatomic differences in the upper and lower rectus muscle as related to the location of this lesion.

The presence of a cough as a factor in the etiology of this condition is shown by its having been found in over one-third of all patients. The factor of cough being contributory is even more apparent when it is again noted that it was present in 60 per cent of pregnant women having a hemorrhage into the rectus sheath.

Pain was the most constant finding in the patients of the cases reviewed, occurring in all instances. The severity was related to its location, the degree of hemmorrhage and other associated factors. Some patients reported a sensation of something *breaking loose*, or a *tearing sensation*.[52] After cessation of active bleeding, the hematoma becomes quiescent and the pain usually diminishes or may completely disappear. Evidences of peritoneal irritation would be expected when the hemorrhage occurs in the lower portions of the muscles where the hematoma rests against the parietal peritoneum. This irritation would be even more evident in patients in whom the hematoma ruptures into the peritoneal cavity with varying degrees of pain and possibly evidence of shock.

A mass occurred as the most frequent finding in 72.8 per cent of the patients in all cases reviewed. The size ranged from that of a lemon to a football, usually movable from side to side but not in a vertical direction. It is made immobile by contraction of the rectus muscle.[52] The presence of a mass on abdominal examination was a more constant finding than palpation of a mass on vaginal or rectal examination. In the patients in the cases reviewed, there were no in-

stances of a mass being present on vaginal or rectal examination which was not palpable on abdominal examination. The mass may not be detected until relaxation of the abdominal wall is obtained either by flexion of the abdominal muscles or under anesthesia. The absence of an enlargement does not exclude the diagnosis of rectus hemorrhage. In 19 patients no mention of a mass was made, and in 10 the absence of a mass was specifically noted. After extravasation of the blood into the substance of the muscle occurs a definite mass would not be expected.

Tenderness is of some significance, since it was noted in 97.5 per cent of the patients of the cases reviewed. That it was absent in only 2.5 per cent of the patients should make one extremely cautious in making the diagnosis of hemorrhage into the rectus sheath in the absence of tenderness.

Rigidity would be expected to occur with greater frequency. It was encountered in only 28 patients of 107 cases reviewed. This may be of some significance since in the majority of instances the abdominal wall is effected without an intra-abdominal involvement. Joffe and Van Ryzin[33] regard the presence of rigidity and tenderness significant in those patients when hemorrhage occurs in the rectus muscle. Rebound tenderness associated with rigidity would not be expected to be present.

Ecchymosis was noted in 17.7 per cent of the patients in the cases reviewed. It was usually seen several days or weeks following the onset of symptoms. Ecchymosis is influenced by the fact that the rectus sheath is a longitudinal band extending in continuity the entire length of the rectus muscle, except in its posterior portion inferior to the semicircular fold of Douglas, which prevents extravasation of blood into the subcutaneous tissues.

Nausea and vomiting most often are not present. They are significant as related to involvement of the peritoneum and blood loss. Other factors contributing to the presence of nausea and vomiting may be the severity of the pain and the associated administration of opiates.

Shock is infrequently seen, as the blood loss is insufficient to interfere with normal hemodynamics or to disturb total blood volume. If there is extensive blood loss and/or rupture of the hematoma into the abdominal cavity, shock may be profound.

Temperatures of the patients in the cases reviewed were normal or mildly elevated. It is rare to find extreme hyperpyrexia with or without chills.

There were instances of severe hypertension noted[13, 17, 38, 60] but whether it can be implicated as a possible etiologic factor is inconclusive. The majority of the patients did not have elevation of the blood pressure.

There have been no reported proofs of the relationship of hemophilia or other blood dyscrasias to this condition. Patients with primary diseases of blood frequently have hemorrhages and may occur equally in all parts of the body.

The literature makes little mention of this condition occurring as a complication of the administration of anticoagulants, although one of the cases reported occurred while the patient was taking dicumarol.

There were 8 deaths in the 107 cases, with a mortality rate of 7.5 per cent. This is surprisingly high in view of the initial relatively innocuousness of the rupture

of a vessel in the abdominal wall with subsequent hemorrhage. Some explanation for this mortality lies in the fact that the average age of the patients who died was 60 years. Also in every patient there were present other disease processes such as hypertension, arteriosclerosis, or other degenerative diseases.

DISCUSSION

There probably have been many spontaneous hemorrhages into the rectus muscle which were never recognized, since they were too small to be palpated. The extremely large ones manifest symptoms which should be diagnosed prior to the time of exploration. The most constant evidences are pain, the presence of a mass and tenderness. The combination of these findings should arouse suspicion of this process. The morbidity is not high, but if there has been a rupture into the peritoneal cavity many complications can be expected. The combination of trauma and pregnancy are not statistically significant although they are factors to be dealt with in this condition.

Hemophilia and other blood dyscrasias have not been prevalent etiologic factors in this condition. At first impression one would expect that such would play a major role in the production. Thorek[62] regards Bouchacourt's sign as a valuable aid in determining the site of a palpable abdominal mass. This sign is elicited by having the patient contract the abdominal wall. If the mass is subcutaneous, it becomes more manifest, and retains its mobility; if it is within the abdominal wall, its characteristics do not change, but assume a peculiar firmness. If it is intraperitoneal it will disappear completely. This is not a valid sign in patients with a flaccid abdominal wall. As has been previously mentioned, Bouchacourt's sign may be an extremely important aid in differentiating the abdominal wall mass and also intra-abdominal tumor. Finally, it is essential that exploration of the mass be made (1) for diagnosis and (2) to control any continued bleeding which usually has stopped by time of exploration and (3) to remove the large hematoma to lessen the possibility of slow resolution and possible abscess formation.

The mortality of 7.5 per cent is apparently high but it should be re-emphasized that the hemorrhage into muscle alone does not produce death. The associated general condition usually is responsible.

SUMMARY

Two cases of spontaneous hemorrhage into the rectus muscle are reported.

A review of 107 cases in the literature have been made. The pertinent symptoms in this group have been correlated.

The presence of pain, a tumor, and tenderness were the most constant findings.

The problem primarily is that of differential diagnosis of the mass. This is not easy and exploration is frequently required both for diagnosis and therapy.

One should be alert to this condition in order that early treatment be rendered to lessen the morbidity and high mortality rate.

CASE REPORTS

Case 1. Mrs. S. N. W., a white woman, was admitted to Emory University Hospital on Jan. 25, 1953. One week prior to admission she became very dizzy and was treated in another

hospital, for a kidney infection and influenza. Her condition became progressively worse, developing abdominal pain, nausea and vomiting associated with headache. On physical examination the patient was drowsy and uncooperative. Her blood pressure was 185/110, with a normal temperature. Her abdomen was markedly distended and hyperresonant to percussion. A firm mass, measuring 12 by 10 cm., was felt above the pubis in the right lower quadrant. Peristalsis was absent. The white blood cell count on January 25 was 14,600 per cu. mm. Other laboratory data were noncontributory.

On pelvic examination the mass was palpable. The diagnoses of intestinal obstruction, twisted ovarian cyst or volvulus were entertained.

Operation was performed soon after admission. A paramedian incision was made in the right lower quadrant. Upon carrying the incision down to the right rectus muscle a large hematoma containing some 1000–1500 cc. of blood, which had dissected laterally into the right flank was found. No bleeding point could be identified. The peritoneum was torn underlying the area and part of the blood appeared to be within the peritoneal cavity. Exploration revealed no abnormalities. The abdominal wall was carefully debrided and closed in layers without drainage.

The patient had a stormy postoperative course, complicated with electrolyte imbalance but recovery was satisfactory and she was dismissed from the hospital on March 2, 1953.

Case 2. Dr. E. B., a 38 year old female physician, was in good health until 11 days prior to admission to Emory University Hospital when she had a sudden chill followed by headache, malaise, and fever. She continued having chills and fever and developed a slight cough. Blood cultures and chest films were negative. Four days prior to admission she developed an unproductive cough and pain in the left leg. This latter condition increased and was thought to be an acute thrombophlebitis. She was given 300 mg. of dicumarol and 300 mg. of heparin on the day of admission. In addition to the findings related to respiratory and vascular disorders, she had slight tenderness over the area of an old McBurney's incision on admission to the hospital.

At the age of 15 years, she had an appendectomy followed by thrombophlebitis of the left leg.

On the night of admission this patient complained of right lower quadrant abdominal pain intensified on coughing. Examination at that time revealed marked tenderness in the right lower quadrant and rebound referred to the area of the abdominal scar. Pelvic examination was negative. The diagnosis of partial intestinal obstruction was made. Roentgenogram of her abdomen showed a moderate amount of gas in the small intestine, compatible with an ileus. The white blood count was 11,400 and other laboratory studies were normal. Due to a continuation of the pain for 24 hours, it was thought that an exploration should be done.

After the patient was anesthetized, palpation of the abdomen revealed an elongated mass in the right lower quadrant occupying the area of the lower right rectus muscle. A lower midline incision was made and when the anterior right rectus sheath was exposed it was noted to be dark and hemorrhagic. The sheath was opened and 200 cc. of blood was evacuated. No definite site of the bleeding could be seen. A Penrose drain was inserted into this area and the rectus sheath closed. The abdominal cavity was not explored. The postoperative course was uncomplicated and the patient was discharged on the tenth postoperative day.

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ANNULAR PANCREAS

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Annular pancreas is an uncommon developmental anomaly which is produced by a ring of pancreatic tissue which surrounds the second portion of the duodenum and may cause varying degrees of obstruction. The remainder of the pancreas apparently is normal.

The significance of annular pancreas lies in the fact that conditions causing swelling of the pancreatic ring, such as hemorrhage, pancreatitis, hypertrophy, etc., or as in one of our cases, foreign body obstruction, may rapidly bring on acute intestinal obstruction. In occasional instances it causes complete duodenal obstruction.

Tiedmann usually is given credit for first recording this anomaly in 1818,[7] Decourt in 1830, and Moyse in 1852.

In 1862, Ecker[2] gave the name "Annular Pancreas" to an anatomic finding in which a band of pancreatic tissue encircled the second portion of the duodenum. From this time until 1905, when Vidal treated the first patient surgically, the only cases reported were occasional cases noted as incidental findings at autopsy.

Incidence: In over 20,000 autopsies at the Johns Hopkins Hospital, up to 1950, annular pancreas had not been recorded as a finding. A total of approximately 85 cases have been reported in the world literature.

Embryology: In 1933, McNaught,[7] of the Department of Pathology, Stanford University School of Medicine, reviewed the subject of embryologic development of the pancreas in great detail, and his paper has been referred to by most authors on annular pancreas.

Briefly, the human pancreas develops in the embryo from two distinct entodermal outgrowths referred to as the dorsal and ventral anlages, respectively. During the fourth week of embryologic life the dorsal anlage appears on the dorsal wall of the intestinal tract slightly above the level of the common bile duct. The ventral anlage appears in the angle formed by the hepatic diverticulum and the intestine. Most embryologists describe a right and left lobe of the ventral anlage. As the embryo develops, rotation of the stomach and elongation of the bile duct cause the ventral anlage to approach and ultimately unite with the dorsal anlage.

Embryologists are not certain whether the left bud of the ventral anlage usually atrophies or whether it persists and along with the right bud enters into the formation of the uncinate process and ventral portion of the head of the pancreas. However, when annular pancreas occurs, we are inclined to agree with Lehman and others that the left bud of the ventral anlage continued to develop and became abnormally fixed to the intestine ventrally, so as rotation occurred, a ring of pancreatic tissue was pulled about the duodenum.

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McNaught[7] quoted Baldwin as stating: "It is a significant fact that the specimens of annular pancreas which have been dissected show a duct traversing the ring and joining dorsally with the main pancreatic duct, not emptying into the accessory duct. This seems to indicate that this ring of tissue is either a persistence of the left half of the ventral anlage, or an excessive growth from the right half of the same anlage. If it is the latter case, the excessive growth has taken place ventral to the duodenum, and to the left, at the time that the remainder of this same half was growing or being carried dorsally to ultimately fuse with the head of the gland".

When the ring is incomplete, the defect is always anterior, further suggesting that the origin of this band of tissue is most likely from the ventral anlage.

Sex and Race: The sex of the patients has not been given in all reported cases, but where the sex has been given, various authors report between 57 per cent and 72 per cent as occurring in males. Annular pancreas has been found to occur in Negro, Oriental and white patients.

Diagnosis: Annular pancreas has been diagnosed as early as 3 days of age and in patients 74 years of age. A higher percentage of this congenital anomaly remains asymptomatic until adult life than any other congenital anomaly. Twenty per cent of the cases are associated with other congenital anomalies.

The correct preoperative diagnosis has been made in only a few instances. When the obstruction from annular pancreas is complete, roentgenologic examination will reveal obstruction of the second portion of the duodenum and when the obstruction is complete, the symptoms are those of high intestinal obstruction.

Demonstration of the "double bubble" phenomenon on a flat film of the abdomen is indicative of obstruction of the second portion of the duodenum. It is produced by gas in the stomach and in the dilated first portion of the duodenum and is demonstrated in figure 6.

When the obstruction is incomplete, McGee and associates[6] mentioned that the "unchanging character and size of the duodenal lumen seemed to be important diagnostic features".

The symptoms usually are not manifested until some other factor, such as pancreatitis or foreign body obstruction, produces additional obstruction at the site of the reduced lumen in the duodenum, again producing symptoms of high intestinal obstruction.

Treatment: When the condition of annular pancreas becomes symptomatic and is diagnosed, the correct treatment obviously is surgical. The surgical management of this condition has consisted of two methods of attacking the problem, namely: direct attack on the ring itself and the utilization of some by-passing procedure.

The first 4 patients with annular pancreas to be treated surgically were treated by gastroenterostomy and this procedure is still used most frequently in the treatment of this condition.

While it may seem more logical to remove a portion of the constricting band of pancreatic tissue, fistula formation and pancreatitis have been frequent complications of this method of treatment.

In 1930, Howard[4] divided the pancreatic ring and because of the distressing complications, advanced the idea of duodenojejunostomy. However, this method of treatment was not employed surgically until 1944, when Gross and Chisholm[7] reported a successful case in which duodenojejunostomy was employed for the treatment of annular pancreas. Since that time, duodenojejunostomy has become more widely used because it seems to more adequately drain the proximal duodenal segment.

While we have had no experience with jaundice associated with annular pancreas, a review of the literature shows that jaundice was associated with annular pancreas in 12 cases studied during the first year of life of the patient.

A study of the results of these cases indicates that relief of the obstruction of the intestinal tract may not effect relief of the biliary tract obstruction which is thought to result from the annular ring of pancreatic tissue obstructing the ampulla and not to the distended proximal duodenum, and that if clinical jaundice is significant, cholecystoenterostomy should be strongly entertained as a procedure at the time of the correction of the intestinal obstruction.

CASE REPORTS

Case 1. D. H., a six year old white boy, the son of a physician, was seen first in early December 1953, complaining of intermittent abdominal cramping pain since October 1953. The first attack occurred while the patient was at school and began with abdominal cramping pain and diarrhea. After a few hours the pain and diarrhea subsided but recurred during the night when it was associated with vomiting. The pain, which was severe enough to cause the patient to get down on the floor and roll about, was relieved by Demerol.

During the next 6 weeks, the patient had 4 additional attacks of severe pain similar to the first attack, but unaccompanied by diarrhea. In the early part of December 1953, a roentgenogram of the abdomen was taken which showed an opaque object resembling a coin in the right upper quadrant of the abdomen (fig. 1). Barium studies were obtained which revealed the foreign body to be located in the proximal duodenum (fig. 2). Since the foreign body did

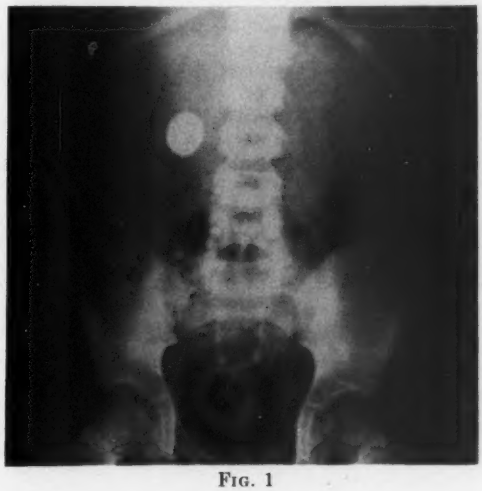

FIG. 1

FIG. 2

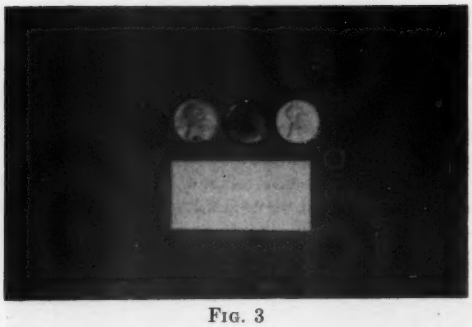

FIG. 3

not move during more than a week's observation, it was recommended that it be surgically removed.

The patient had had no previous operations or serious illnesses. There were 3 other siblings in the family who were healthy.

Physical examination revealed a normal, six year old white boy in apparent good health. There were no abnormal physical findings. Routine complete blood count and urinalysis were normal.

On Dec. 28, 1953, laparotomy was performed. The preoperative diagnosis was: foreign body of the duodenum.

Under general anesthesia the abdomen was opened through a right upper rectus incision. The distal half of the second portion of the duodenum was obscured by the colon. The proximal duodenum was dilated to approximately 2 times normal size and the musculature of this portion of the duodenum and the stomach seemed hypertrophied. The foreign body in the duodenum was identified by palpation, and since it was movable, we thought it could be more safely removed through a gastrotomy. The stomach then was opened proximal to the pylorus and the foreign bodies easily removed. What was thought to be a single foreign body, turned out to be 3 pennies and an apricot pit (fig. 3). In order to ascertain why the foreign

bodies had not passed, the lumen of the duodenum was explored with the examining finger and after some difficulty due to the redundancy of the proximal duodenum, we eventually located a very narrow outlet from the proximal duodenum. This outlet would just admit the end of the index finger.

The colon was next dissected off the region of the distal duodenum and the primary pathology became apparent: a band-like structure of pancreatic tissue 1 cm. in diameter was found completely encircling the duodenum at the level of the ampulla. It seemed to be inseparably fused with the head of the pancreas at each end of this band of tissue. Its yellow color resembled that of the pancreas; however, its texture was smooth and less lobular than the head of the pancreas (fig. 4). Since it separated from the wall of the duodenum so easily, we were tempted to treat this patient by division of the band of tissue. A segment of the

FIG. 4

FIG. 5

center of the band was thereupon removed, tying each end of the remaining portion of the band with no. 000 silk. After the annular portion had been completely freed from the duodenum, there seemed to be a constriction present in the duodenum which caused us concern, and it was treated by a Heineke-Mikulicz duodenoplasty, which resulted in an adequate lumen.

The gastrotomy wound was closed followed by closure of the abdomen. The patient's convalescence was uneventful.

The microscopic examination of the segment of tissue removed showed it to be composed entirely of vascular fibrous tissue. No islet nor acinar tissue was identifiable. Despite this, the photograph in figure 4 leaves little doubt as to the origin of this band of tissue.

The patient has had no recurrence of his symptoms and roentgenograms taken 1 year postoperative reveal a normal gastrointestinal tract (figure 5).

DISCUSSION

In 1952, Wilson and Bushart[12] analyzed the reported cases in which the patients were treated surgically and found 14 had been treated by direct attack on the pancreatic ring itself. They noted that 4, or 28.5 per cent, developed pancreatic fistula and 2, or 14.2 per cent, had persistent symptoms of obstruction following division of the ring.

Twelve other patients who had been treated with a by-passing procedure developed no complications directly referable to the operative procedure. Despite these figures, some authors still leave the impression that direct attack on the ring is an acceptable procedure.

While the case just presented turned out favorably, we believe that our good fortune was, in part, due to the fact that the pancreatic tissue had become replaced by fibrous tissue, probably due to pressure factors, and thus removed the dangers of fistula formation and/or pancreatitis.

Since the ring of pancreatic tissue separated from the duodenum with ease, we anticipated the calibre of the duodenum would be normal after the ring had been divided. However, to our surprise, there was little change in the calibre of this segment of the duodenum after the ring had been divided. Thus we felt compelled to add duodenoplasty to the procedure in order to prevent possible future recurrence of symptoms. We believe duodenojejunostomy is no more hazardous than the Heineke-Mikulicz duodenoplasty and avoids the risk of pancreatitis and/or fistula formation.

This case represents the first recorded case where attention has been drawn to the condition of annular pancreas by intermittent intestinal obstruction due to foreign bodies lodging proximal to the narrowed zone of the duodenum. Had the patient not ingested the foreign bodies, this case would most likely have gone unrecognized unless some other pathologic process, such as pancreatitis, produced partial or complete obstruction.

Case 2. R. V., a Spanish female born Jan. 13, 1955, at 4:53 a.m., cried spontaneously. Examination at birth revealed a well developed infant who weighed 6 pounds, 10 ounces and exhibited no abnormalities. The complete blood count, and urinalysis were normal.

On Jan. 14, 1955, projectile vomiting was noted which contained no bile. Vomiting occurred once more later in the day.

On Jan. 15, 1955, a flat film of the abdomen revealed no small bowel gas, but the "double

FIG. 6

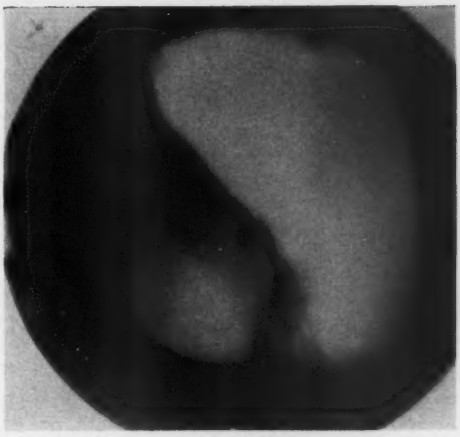

FIG. 7

bubble" phenomenon was demonstrated (fig. 6). Radiopaque media was injected into the stomach through a small indwelling tube and demonstrated a complete obstruction of the second portion of the duodenum (fig. 7).

At 4:00 p.m., on Jan. 15, 1956, the patient underwent laparotomy under general anesthesia with a polyethylene tube in the left long saphenous vein. The preoperative diagnosis was: congenital duodenal obstruction due to annular pancreas or congenital atresia.

The abdomen was opened through an upper right rectus incision. The proximal duodenum was found to be at least 2 cm. in diameter. The midportion of the descending limb of the duodenum was completely obstructed at the point where a band of pancreatic tissue was wrapped about it. This band of pancreatic tissue was 1.5 cm. in width, and had the yellowish color and lobular appearance of normal pancreatic tissue. The annular portion of the

FIG. 8

pancreas was apparently just proximal to the ampulla as no bile was found in the proximal duodenum, but was present in the distal portion. An isoperistaltic duodenojejunostomy was then done making the stoma as far distal in the proximal duodenum as possible in order to avoid the formation of a blind pouch between the stoma and the obstructed portion of the duodenum. The anastomosis was moderately difficult from a technical standpoint due to the discrepancy in size of the bowel; the distal portion being not more than 8 mm. in diameter.

At the completion of the anastomosis, we could force gas through the stoma which gave us confidence that the anastomosis would function.

The baby's convalescence was uneventful; however, no gastrointestinal function had been observed by the third postoperative day, so we became a little apprehensive and repeated the injection of radiopaque material into the stomach. At first none of the material passed through the stoma, but by the end of the first hour we were relieved to see the radiopaque oil in the upper jejunum. At the end of 4 hours, 50 per cent of the oil has left the stomach (fig. 8).

Thereafter convalescence was rapid and uneventful.

The patient has developed normally and has remained in good health except for a rather severe anemia of undetermined etiology or type.

A roentgenogram taken on March 29, 1956, demonstrated a normally functioning duodenojejunostomy with no blind pouch formation. The obstruction at the site of the annular portion of the pancreas has remained complete.

DISCUSSION

This case reported represents the youngest patient treated surgically.

The presence of projectile vomiting indicated obstruction high in the gastrointestinal tract. The absence of bile in the vomitus suggested the obstruction was proximal to the ampulla of Vater. The radiopaque study of the stomach located the obstruction in the duodenum and indicated it was complete. The differential diagnosis of the lesion producing this picture is annular pancreas, congenital atresia or diaphragm of the duodenum or mal-rotation of colon with

incomplete descent of cecum and resultant pressure on duodenum. The fact that we listed annular pancreas as the first diagnosis is nothing more than beginner's luck.

A rather severe anemia was recognized before the child was 1 year of age; however, development has been perfectly normal and no other anomalies have been apparent. At the present time an intensive study is being made to determine the etiology and type of anemia present.

In considering nutritional problems, we believe that when a complete duodenal obstruction occurs from annular pancreas, it is important to place the side to side duodenojejunostomy close to the obstruction in the duodenum in an attempt to prevent the formation of a blind pouch which may enlarge and become symptomatic.

Gastroenterostomy was employed in the treatment of congenital hypertrophic pyloric stenosis in the past, but a significant number of these patients developed marginal ulcers at puberty. While this complication has not been reported following gastroenterostomy for annular pancreas, we believe it should be considered as another factor in favor of duodenojejunostomy.

SUMMARY

The historic background, embryologic development, diagnosis and treatment of annular pancreas are briefly discussed.

A case of annular pancreas is reported in which the patient was operated upon because of ingested foreign bodies which produced intermittent intestinal obstruction.

A case is reported of complete duodenal obstruction due to annular pancreas, diagnosed and surgically treated on the second day of the patient's life.

The significant points in the surgical correction of this condition have been discussed. Duodenojejunostomy is recommended as the treatment of choice for annular pancreas.

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FUNCTIONING TUMORS OF THE ADRENAL CORTEX

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No part of the human anatomy has aroused more interest than the adrenal gland. Eustachius[4] may have been among the early men to describe this organ some 400 years ago. Bartholenus[14] talked about the round bodies adjacent to the upper poles of the kidneys filled with "*black bile.*" Many authors believe that this was characteristic of the post mortem autolysis that took place and probably was misinterpreted. The discovery of epinephrine[3, 15, 16] in 1894 and 1895 was the first real information about the gland. In 1917, it was discovered that demedulation was possible without serious results.

Why such a gland is made up of two components so different in origin and function is not understood. The medulla originating from the neural tube has less significance than the other component—the cortex—which comes from a mesothelial ridge. The normal function of the latter is homeostatic.[12] It comes into play probably after the medulla has had an immediate part in an "*alarm reaction*". The fact that this gland is so well protected in its position in the body is evidence of the vital part it has to play.

It is our purpose to concern ourselves with tumors of the cortical part of this gland. We have one case to present that possibly is not classified as a tumor.

CASE REPORTS

Case 1 was a 2½ year old child, (K. DeV.) apparently a female. She was a first child normally born. She came to our dispensary Feb. 19, 1948 and was admitted to the pediatric service. There were masculine traits in addition to an enlarged clitoris which measured nearly 1 cm. in thickness and over 3 cm. in length. The labia and vagina were very rudimentary; there was a small urethral opening at the base of the penile like organ, giving the appearance of hypospadius. This rudimentary vagina admitted a small probe with difficulty (fig. 1). However it was found to be patent and to communicate with a fairly normal cervix. Pubic hair was present. The blood sugar curves were normal. Several 17-hydroxy Ketosteroid determinations were made. The average was reported at 14.2 mg. in 24 hours. The androgens were reported to be increased.

A diagnosis of pseudohermaphroditism in the female was made. In 1948 the abdomen was explored and a biopsy was taken from the ovaries. This established the sex and convinced us that she didn't have an ovarian cell tumor. An increase in the size of the adrenals was noted at operation.

Three months later the right adrenal region was explored through a posterolateral approach. Seven and one half grams of hypertrophied adrenal tissue was removed. The left side was not explored. Postoperatively her temperature ranged as high as 105 degrees, her pulse was rapid and general cyanosis developed. She died on the second postoperative day.

Necropsy findings were: The parotids and right submaxillary glands were enlarged There also was an enlarged clitoris. It was established that the vagina communicated with the cervix. Also there was edema of the brain, lungs and kidneys and pleural and pericardial effusion. Special note was made of the large right adrenal gland which weighed 15 grams. The right kidney weighed only 30 grams.

Case 2 was a white man, aged 47. A year before coming into the hospital he presented

FIG. 1. Case 1. Pseudohermaphroditisim in a female 2½ years old—evident from time of birth. Hypospadius like deformity not visible from this view.

FIG. 2. Case 2. A 47 year old man had demonstrated large painful breasts and had lost weight. Note definite evidence of swelling in left side, often a presenting symptom.

himself with large painful nipples. A diagnosis of gynecomastia was made. Studies at that time revealed a mild anemia; negative urinalysis, and the liver function tests were within normal limits. The fasting blood sugar was 85 mg. per cent, and an intravenous pyelogram was normal.

On hospital admission his outstanding findings were: loss of libido, tender breasts and a left varicocele of less than 1 year duration. The testicles were thought to be small. He was weak and nervous and there was moderate elevation of his blood pressure (170/90). There was evidence of enlargement in the left flank and hypochondrium (fig. 2).

An intravenous pyelogram revealed some rotation of the left kidney and a lateral film of the upper gastrointestinal tract showed forward displacement of the stomach (fig. 3).

This large tumor was approached through a left subcostal incision. It was encapsulated and presented itself from above the stomach and behind the pancreas. It was attached to the kidney capsule.

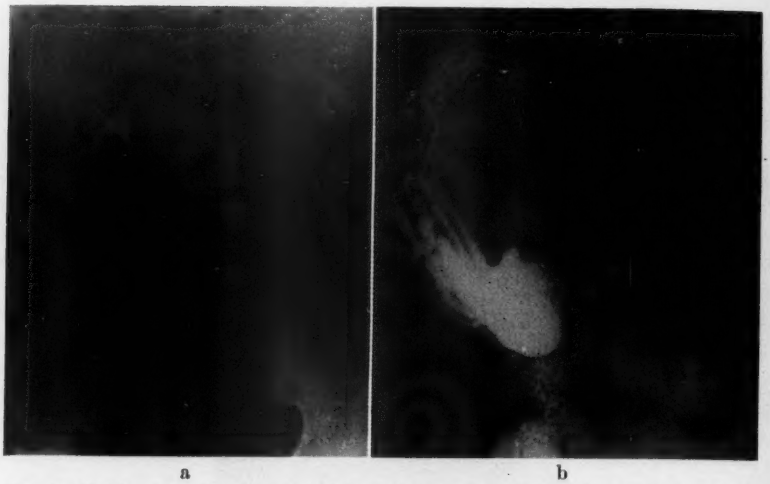

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FIG. 3a. Evidence of disturbance in left pyelogram; rotation. b. Upper gastrointestinal study shows forward displacement of stomach.

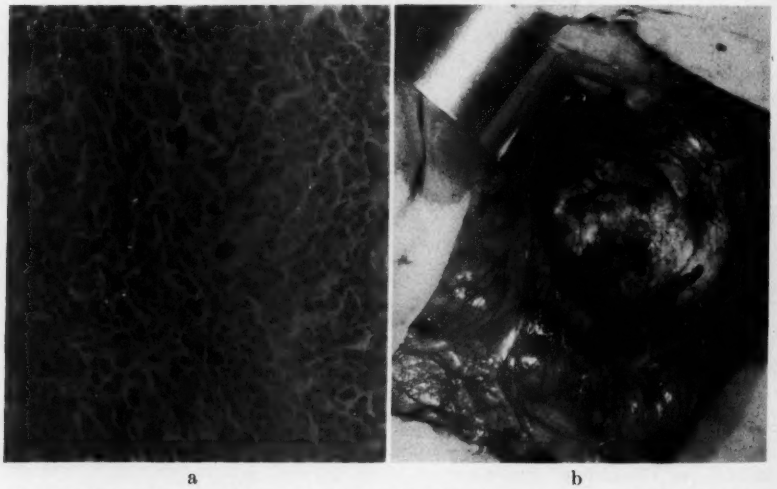

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FIG. 4a. Photomicrograph demonstrating cellularity of growth with many mitotic figures. b. Large tumor presenting through subcostal incision.

In most cases of feminizing tumors of the male, the tissue is highly malignant. The tumor and its rich cellular structure which indicates such a change is illustrated in figure 4.

The patient's convalescence was practically without event. In view of the interest in this case, extensive metabolic studies were carefully recorded.

Figure 5 graphically depicts the postoperative management with cortisone and ACTH. There is more than a suggestion that there is an increase in the 17 hydroxycorticoids even as early as January. The patient had been operated upon the preceding December.

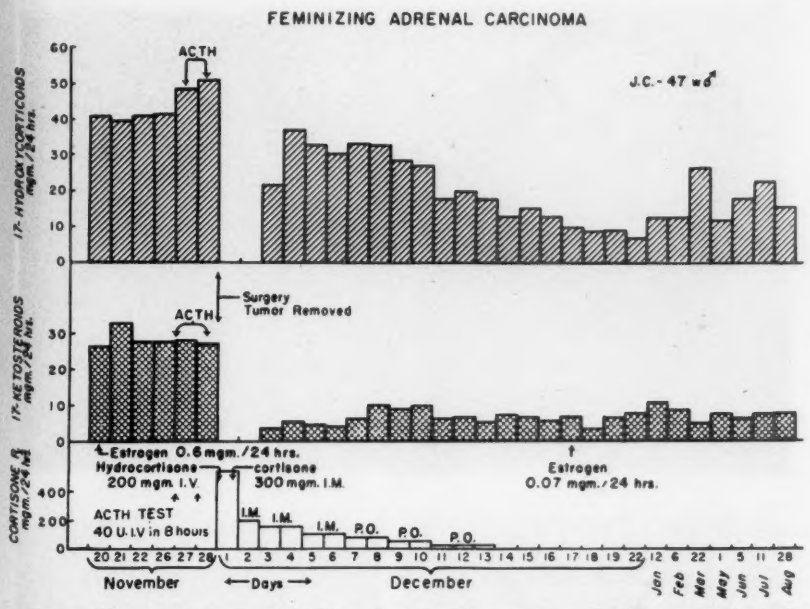


FIG. 5. Measurement of metabolites of cortical hormones pre and postoperative. The increase in 17 hydroxycorticoids in January would suggest a recurrence of the growth. Management of cortisone therapy postoperatively is indicated on bottom line.

Pregnandiol was reported as being 15.8 mg. in 24 hours before surgery and measured 3.8 mg. after surgery. Beta ketosteroids were 2.2 mg. and alpha ketosteroids were 24 mg. in 24 hours. Our laboratory regarded this ratio as being normal. The estrogens were markedly increased.

Case 3, a 31 year old married white woman was admitted to the hospital on May 11, 1949. She has been in good health until the summer of 1946, when she first became aware of weakness of her legs and abnormal fatigability. Her weight was 132 pounds.

During the summer of 1947, she first became aware of a change in her appearance. Her face became fatter and more rounded and she appeared flushed. In addition there was a moderate increase of hair on her face, chin and upper lip. A few months later she began to have throbbing headaches and it was noticed that she was nervous and irritable, crying at the slightest provocation.

In the fall of 1947 she consulted a physician, but received no help. Early in 1948 her menstrual periods became irregular and scant and shortly thereafter ceased. At that time she also noted reddish, purplish streaks on her abdomen, breast and thighs, with gradual weight gain. Her abdomen became protruberant and the obesity of the face, neck and shoulders increased. By the spring of 1949 her activities were limited markedly because of profound weakness, shortness of breath on exertion, and attacks of "*palpitation*". She again sought medical attention and reported to our clinic on May 11, 1949 (fig. 6).

Physical examination revealed: height 63 inches and weight 162 pounds. Her skin was warm and moist and unusually thin with several areas of ecchymosis. Moderate obesity was confined to her face, trunk and abdomen. The extremities appeared small by contrast and showed some degree of muscle wasting. Her face was rounded and full and an excess of hair was present on the cheeks, chin and upper lip. No acne was noted. Reddish purple striae were present in the skin over the breasts, abdomen and buttocks and there was a peculiar

a b

FIG. 6a and b. Case 3. A 31 year old woman demonstrates the marked change which occurred in this patient over a period of 3 years. Notice the typical moon facies.

cyanotic mottling of the skin over the legs. The breasts were large and pendulous and the external genitalia appeared normal. The pelvic examination gave the impression of a small uterus. There was muscular weakness in the lower extremities. Her blood pressure was 160/120 and her pulse was 100 per minute. The peripheral arteries were not sclerotic. The abdomen was protuberant and flabby and no masses were palpated.

Following extensive laboratory examinations, the patient was taken to surgery on May 31, 1949 where both adrenal glands were explored through posterior lumbar incisions. A tumor measuring 2.5 by 3 by 4 cm. was present and removed from the right adrenal gland (fig. 7). It was encapsulated and appeared to have invaded the upper two thirds of the adrenal gland. Pathologic examination revealed it to be a benign adrenal cortical tumor. The left adrenal gland appeared slightly atrophic.

Adrenal cortical extract was administered before and after surgery. Her immediate postoperative course was uneventful. However, 2 weeks postoperative she developed a pneumonitis and wound infection. It was necessary to continue the administration of cortical extract for a period of approximately 1 month.

During the ensuing 2 months she improved steadily. There was gradual return of appetite, strength and endurance and there was substantial disappearance of the cardinal features of Cushing's syndrome. Menstruation was resumed on Oct. 8, 1949, the first period since February 1948 (fig. 7B).

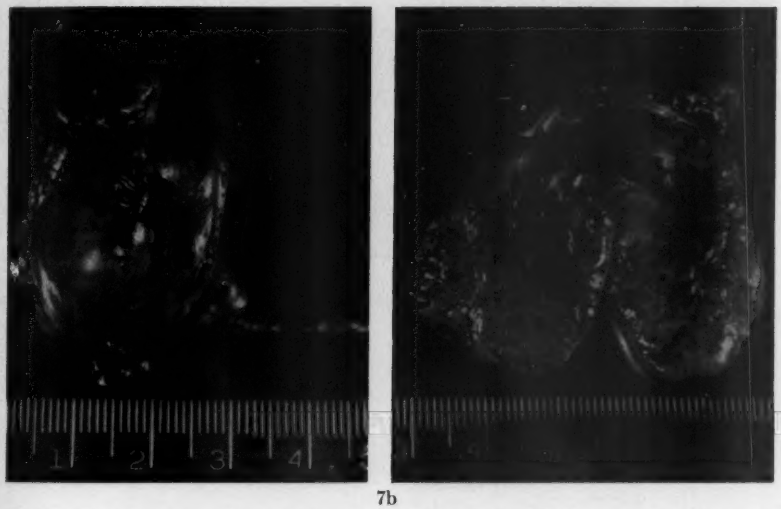
This patient had shown a moderate increase in the amount of 17 hydroxy-ketosteroids excreted in the urine, however, their level fell to normal following removal of the adrenal cortical adenoma.

Seven years have elapsed since this patient was operated upon and there have been no signs of recurrence of symptoms.

In contrast to the preceding case of benign adrenal adenoma, the following case is that of a primary adrenal carcinoma.

Case 4 was a 38 year old white woman, who was well until February 1954, when she noted a rash beginning over the anterior chest wall and spreading to her shoulders and face. She

7a



7b

FIG. 7a. Case 3. Same patient as figure 6. b. A tumor 2.5 by 3 by 4 cm. removed from right adrenal gland.

consulted a dermatologist and was given an elimination diet and nonalergic soap. The rash continued to become more severe and her voice became very coarse and husky.

About the middle of March, the patient's appetite increased and she gained 29 pounds in weight in 5 months. Her face became more round and full. She formerly wore a size 4 shoe but 4 to 6 weeks prior to hospital admission, her ankles enlarged to the point that a size 6 shoe was required, her waist line increased from 25 to 30 inches. Abdominal striae had been present since her pregnancies. Her last normal menstrual period was on Feb. 20, 1954, 5 months prior to hospital admission.

Also about this time the patient began to experience rather severe headaches. She stated that they were present when she would awake in the morning, being frontooccipital in character. Relief could be obtained with 2 to 3 Anacin tablets daily.

The patient noted that her complexion became flushed and ruddy. The hair on her head was brittle and combed out easily. Body hair increased in amount and for the first time there was noted hair in the areolar of the breast.

She was hospitalized on July 1, 1954, at which time she appeared round faced, well developed, cooperative and alert. Her blood pressure was 180/102, pulse 102 and her temperature was 98.6. There was masculine distribution of hair over her face, arms, areolar of the breast and the legs. Her skin was dusty red with a papulopustular rash over her trunk and face. Striae were present over her abdomen and hips (fig. 8).

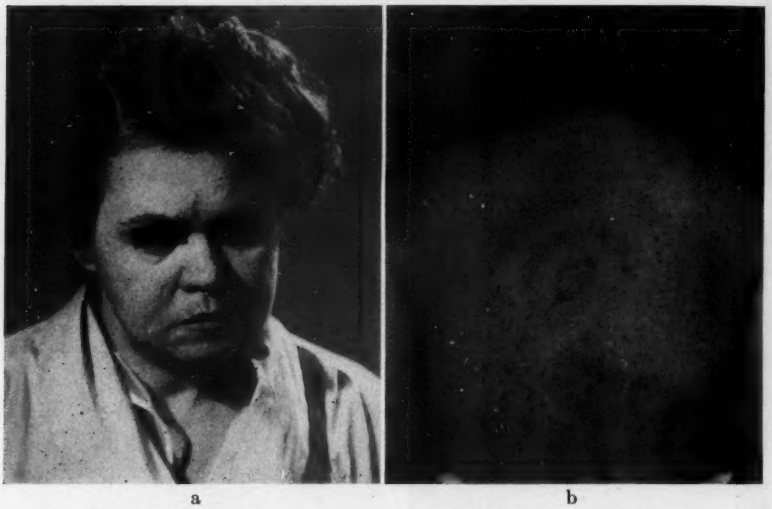


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FIG. 8a. Case 4. A 38 year old woman had masculine distribution of hair. b. Her skin was dusty red with a papulopustular rash over her trunk and face.

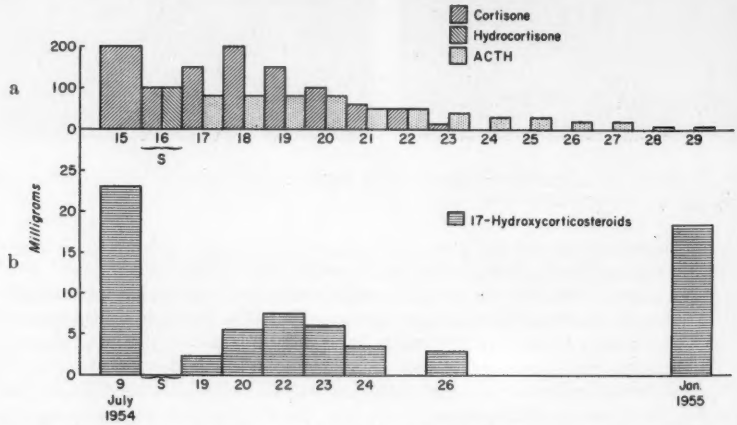


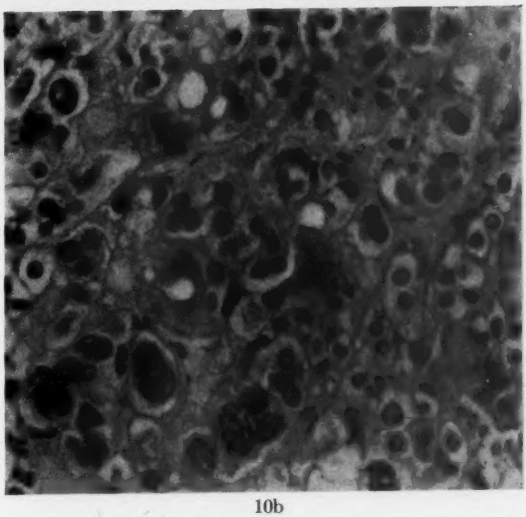
FIG. 9a. Case 4. Same patient as figure 8. b. Urinary hydroxysteroids determinations

Her breasts were not atrophic and no abdominal masses were palpated. The clitoris was thought to be about twice the normal size. Examination of the adnexa revealed no palpable masses in the region of the ovaries.

This patient's preoperative and postoperative management as well as the urinary hydroxysteroids determination is illustrated in figure 9.

On July 16, 1954, the pelvis and both adrenal regions were explored through bilateral subcostal incisions. The ovaries and left adrenal gland were found to be normal. A tumor was found in the right adrenal gland (fig. 10A). The gross specimen was irregular, lobulated and reddish orange in color, measuring 9.3 by 6.5 by 4 cm. Microscopic sections revealed neoplastic proliferation of the adrenal cortex. The cell architecture was characterized by

10a



10b

FIG. 10a. Case 4. Tumor found in right adrenal gland measured 9.3 by 6.5 by 4 cm. b. Microscopic sections revealed neoplastic proliferation of the adrenal cortex.

FIG. 11

considerable irregularity in size, shape and staining qualities. The capsule was infiltrated and mitotic figures were present. Final diagnosis was "*adrenal cortical carcinoma*" (fig. 10B).

Due to the nature of the tumor, irridiation therapy was attempted, however the patient reacted severely to it, therefore it was discontinued. It was necessary to rehospitalize her on Aug. 7, 1954. Her 17 hydroxy-ketosteriods fell from 4.5 mg. on August 6 to 0.1 mg. on August 8. She was placed on 10 mg. of ACTH gel twice daily and showed an immediate response. Her acne disappeared rapidly and the hair distribution became more normal (fig. 11).

She then remained asymptomatic until January 1955, at which time she was readmitted with a complaint of acute right upper quadrant abdominal pain. Her 17 hydroxy-ketosteroid study at this time was 18.5 mg. per cent (fig. 9). Gallbladder roentgenologic examination showed semiopaque biliary calculi. Abdominal exploration on Jan. 18, 1955 revealed marked tumor involvement in the region of the porta hepatis. Subsequent pathologic examination of an omental implant revealed cellular structure consistent with carcinoma of the adrenal cortical tissue. Her postoperative course was uncomplicated and she was discharged on Jan. 26, 1955.

In April 1955, almost 15 months from the date of the original onset of symptoms, she again was hospitalized with reappearance of masculinization. She died following severe gastrointestinal hemorrhage.

SUMMARY

Four case reports of the variable influences and characteristics of tumors of the adrenal cortex are presented:

1. Congenital hyperplasia with the development of pseudohermaphroditism.
2. Carcinoma of the adrenal cortex with the production of a feminizing syndrome.

3. Benign adenoma.
4. Carcinoma of the cortex with virilism.

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SURGICAL TREATMENT OF THE CANCER PATIENT

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INTRODUCTION

In 1792, John Howard of Middlesex Hospital in England,[8] made the recommendation which resulted in the organization of the first cancer service in a general hospital. Here 12 beds were assigned to patients with cancer who might remain "until either relieved by art or released by death."

Although many patients with cancer still are "released by death," we have developed and are in the process of furthering a science that will aid the "art of medicine" in relieving and even curing the cancer patient. This science of cancer therapy is almost wholly a phenomenon of the twentieth century. It is an expansion of the discoveries made during the nineteenth century, particularly the latter part, and their subsequent development to the present time. The progress thus made must be viewed in retrospect over a period of time in order to detect advances, as one does with a phase lapse movie record.

Of the three disciplines of cancer therapy—surgery, radiation therapy and chemotherapy—the first is at present most useful both for cure and palliation. The use of surgery in some form is by far the oldest method of treatment, the first removal of a breast for carcinoma having been recorded by Leonides of Alexandria[11] in the second century after Christ. The developments in surgery and increased knowledge regarding it, however, did not provide a planned attack of such radical nature as to bring about cures until the latter part of the nineteenth and the first part of the twentieth century.

As an example, the first patient to survive following removal of a gastric cancer was operated upon by Billroth[1] in 1881. However, it was not until 1915 that the first patient to survive 5 years following gastric resection was reported.[2] When Friedenwald[9] reviewed 1,000 cases of gastric cancer reported prior to 1914 he found that only 1 of the 1,000 patients survived for as long as 1½ years; all the others died of gastric cancer. Today, in the major medical centers we find surgeons resecting 1 out of 3 patients, with a 5 year survival of approximately 10 per cent; if lymph nodes are not involved, a 50 per cent survival rate is reached for the same period of time. At present, surgery has about reached its peak of accomplishment in this field and, by the very nature of cancer, will always be limited in expectancy of cure to those patients treated while their disease is local or at most regional in distribution.

Radiation therapy became possible with the discovery of the roentgen ray by Roentgen[21] in 1895, and by the isolation of radium by the Curies[7] in 1898. Its use

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is limited to certain specific sites insofar as cure of the disease is concerned, but it is most useful for palliation. In recent years, with the development of supervoltage mechanisms and radioactive isotopes for use in radiation therapy, this discipline is undergoing re-evaluation. No remarkable changes are expected; however, an extension of its usefulness with some gain in over-all survival percentage and less disability from its use may be anticipated.

The greatest deterrent to progress in radiation therapy at the present time is a lack of competent therapists, i.e., physicians trained and functioning primarily in the application of radiation therapy with the help of radiation physicists. Our present knowledge of radiation treatment leads us to believe that it will suffer the same limitations as surgery insofar as disseminated cancer is concerned. Our hope for the future lies in the development of chemotherapy, although no cancer patient has yet been recorded as cured by any of the various chemicals, drugs, hormones, antibiotics, or serums. Theoretically, a cure is possible by the application of the principles of chemotherapy, and specific progress has been made in the past 10 years toward developing the necessary fundamental knowledge to do so. [10]

But we are concerned today with the immediate care of the patient with cancer, and surgery is our most effective discipline in such treatment. Another consideration is that the majority of patients can have access to a well qualified general surgeon in most areas of our country. The general surgeon is potentially the cancer surgeon, although not necessarily the same. General surgical training and experience are prerequisites to the learning of the philosophy and technics of the surgery of malignant disease. It is those qualities and skills which are required by a general surgeon to make him effective as a cancer surgeon which are the subjects of our discussion.

The science of dissection as applied to the living patient antedated the development of the other surgical sciences by almost a century. Early information to delineate the extent of the surgical dissection required for cancer of a specific site was contributed by LeDran[14] (1685–1770). He maintained that cancer was a local manifestation in its early stages, and spread by way of the lymphatics to regional lymph nodes and through the circulation to various organs. Sir Astley Cooper[4] (1768–1841), first presented a concise clarification of the anatomy of the breast, its lymphatics and tumors. The process of local infiltration and vein invasion was demonstrated by Recamier[11] (1774–1852). He used the word "metastasis" to describe secondary, distant growths from breast tumors.

These early observations were augmented by the contributions of the great anatomists of the latter part of the nineteenth century, who demonstrated the course of lymphatic drainage from various organs. Cuneo and Rouviere[22] particularly, explored in detail the lymphatic routes, thereby establishing a basis for the planning of cancer operations, especially the so-called "en bloc" removal of a diseased organ along with its regional lymphatics. This technic of surgery, removing the regional lymphatics along with the primary lesion, or the so-called in-continuity resection of a malignant diseased area, is the foundation of modern cancer surgery. It was developed to its present clinical usefulness by numerous contributions from independent surgeons in various parts of the world. No one

TABLE I

Surgeon	Date	Operation for Cancer	Five Year Survival		
			Per cent expected survival before op. date	Per cent expected survival after op. date	Per cent survival 1956
1. Halsted[12].....	1896	Radical breast	5	45	56
2. Wertheim[26]..	1905	Radical hysterectomy	5–10	45	55
3. Miles[16].....	1908	Combined abdominoperineal	5	45	55
4. Crile[5].....	1906	Radical neck	10	50*	60*

* Depends on primary site—the one quoted is for lip with submaxillary node involvement.

1. Annals of Surgery, Vol. XXVIII, July–December, 1898, p. 557.
2. British Medical Journal, Vol. II, September 23, 1905, p. 689.
3. The Lancet, Vol. 2, 1908, p. 1812.
4. Journal of American Medical Association, December 1, 1906, p. 1780.

surgeon spontaneously conceived the ideas for the technic of an ideal operation for cancer of a given site, but certain ones crystallized the thoughts of their predecessors and contemporaries and thus formalized a most effective procedure. Examples of these are the combined abdominoperineal resection of Miles[16] (1908), the radical breast resection of Halsted[12] and Meyer[15] (1896), the hysterectomy of Wertheim[26] (1905), and the radical neck dissection of Crile[5] (1906). These and similar procedures, all founded on the progressive development of the knowledge of the basic pathology of cancer, which began with the writings of Müller[17] (1838) and Virchow[25], employed the principle of monobloc resection, perhaps the greatest contribution to cancer treatment. This principle is the basis of all cancer surgery, and knowledge of its applicability constitutes the essential information necessary for effective use. No other principle applied to the treatment of the cancer patient has resulted in such a marked increase in the salvage of patients previously incurable by the technics used. Table 1 will show the immediately changed recovery rate as compared to the expected survival rate prior to the innovation of the operative technic reported.

Only in the last decade have any real *additional* advances been made in the salvage of the patient with cancer treated by surgery. This was accomplished not so much in devising new surgical technics in the treatment of the patient or changing the principles as developed by Miles, Halsted, and the others, but by the reduction in the surgical mortality rate and extending the rate of operability by applying the principles learned through the science of anesthesiology, physiology, and chemotherapy. These new developments in science permitted the use of one stage procedures, and permitted advanced surgery of certain areas not before accessible to surgical intervention. These newly accessible areas included the stomach (total resection), pancreas, certain portions of the liver, and the lung and esophagus. Also, the new technics have permitted the removal of multiple organs which were involved by an extension of a malignant process that has still remained local, and has made such removal possible at an acceptable rate of mortality.

The average physician's surgical experience is limited, with regard to malignant disease. Therefore, an opportunity for special training and a particular interest in cancer is necessary for him to acquire the needed background for proficiency in the surgical treatment of patients with malignant neoplasms. The five major aspects of surgical treatment are biopsy, surgery for cure, for palliation, for prevention and for reconstruction and rehabilitation.

Before surgery is undertaken, the location, the exact type, and the extent of the lesion should be determined. It is axiomatic that biopsy should be performed and histologic diagnosis established before any treatment is begun. Correct incisional biopsy technic necessitates selection of the proper site and removal of tissue adequate for microscopic examination. After diagnosis has been confirmed, immediate definitive treatment should be instituted. In some instances, incisional biopsy is contraindicated. For example, pigmented nevi or melanomas should not be incised for biopsy but should always be completely excised with a wide margin of normal, surrounding tissue. A biopsy report is only as good as the pathologist making the diagnosis. One of the most important elements in the care of the cancer patient is the accessibility of reliable pathologic information to the surgeon. In this regard, Pack[18, 19, 20] recounts the work done by Bloodgood[3] while he was working in Halsted's clinic at Johns Hopkins in 1914. At that time he found that 10 per cent of 542 benign lesions had been incorrectly diagnosed and treated for cancer. The 10 per cent error by such masters of clinical diagnosis as Halsted and Bloodgood would suggest a much higher error by most surgeons of that time. Certainly today one must be cautious in that when in doubt, a lesion is not called a malignant tumor when it is in truth benign.

One of the great aids to a surgeon today is the availability of frozen section technics so that a biopsy specimen can be diagnosed immediately and the necessary treatment undertaken subsequently as a continuous process. The frozen section technic was first devised by Cullen[6] in 1895 and was modified for routine use by Lewis B. Wilson[27] in 1905. Any surgeon who does much cancer therapy owes it to his patients to have this technic available. A recent development utilizing a modification of the cryostat has made frozen section technics rapid and easily mastered, and presents the pathologist with cell form and staining characteristics which he is accustomed to seeing in paraffin fixed sections. Aspiration biopsy of tumors and lymph nodes is an accepted technic but possibly should be limited to those cases in which formal biopsy is troublesome or impossible, or where it can perhaps be substituted for a major surgical procedure, such as a thoracotomy or exploratory laparotomy. F. W. Stewart[24] suggested that aspiration biopsy be restricted to hospitals where the surgeon and the pathologist are experienced in the technic and in the interpretation of such biopsies. An aspiration biopsy that yields only normal tissue should be disregarded.

SURGERY FOR CURE

The primary purpose of performing surgery on patients with cancer is to completely eradicate the disease. This, of course, fails in those instances where the disease has spread beyond the involved organ and its regional lymphatics. The primary neoplasm is removed with a generous margin of normal tissue and the

adjacent zones of lymphatic spread. The extent of deformity resulting, or the abnormal physiologic status that will be a problem for the patient for the remainder of his life, must be balanced against the possibility for cure or substantial increase in the likelihood of a tolerable existence. However, there is no "little" surgical procedure for cancer, as there is no "little" x-ray therapy. A surgical procedure either completely removes the tumor or is unsuccessful as a curative process. Therefore, an adequately radical procedure as a first attempt to eradicate cancer is the most likely to be successful. A simple mastectomy for a "small" early cancer of the breast, or an operation which preserves the anal sphincter, rather than the abdominoperineal resection for a low-lying cancer of the rectum, can only be performed by a surgeon who is unfamiliar with either the pathologic character of the lesion or the technic of the operative procedure.

Preoperative preparation is always necessary prior to embarking upon the extensive surgery required for the eradication of cancer. Even when an obstruction is present, one must properly prepare the patient in order to give him the greatest chance of recovery. This includes the clearing up of infections; the restoration of abnormal electrolyte balance; the alleviation of anemia; the restoration of circulating blood volumes and protein deficiencies; and the correction of other individual deficiencies. Carefully selected anesthesia for the individual operation and an adequate supply of typed blood will eliminate many emergencies while carrying out the radical surgical procedures required for patients with malignant disease.

DISCUSSION OF SPECIFIC POINTS IN TECHNIC

At the time of surgery, after a diagnosis of cancer is established, the surgeon must decide whether the operation shall be performed for cure or palliation. Of primary importance in such a decision is the presence of distant metastasis, tumor implantations, involvement of adjacent structures, the absence of a clear marginal area, nodal spread, adherence to, or invasion of, blood vessels, bones, nerves, somatic structures, and evidence of lymphatic obstruction as shown by edema or free fluid in serous cavities. Any one of these factors plays a role in determining the surgical procedure and its eventual effectiveness as to prognosis. The operation may *vary*, depending upon the pathologic type of tumor, its degree of differentiation and site of origin.

As to details of technic, regardless of the type of operation, transplantation of malignant cells must be prevented. To achieve this, the tissues must be handled carefully; excessive handling and squeezing of the lesion must be avoided; the diathermy knife should be used for sealing lymphatics; and the freed lesion should be covered with gauze packs to prevent direct implantation. Ligation of the efferent blood supply as early in the operation as possible has been advocated as a basic principal. Reuse of hemostats should be avoided, for viable cells can be transplanted from the tumor-bearing area to the wound site. This seeding can be partially avoided by adequately washing or sterilizing instruments between applications. An article, by Robert R. Smith and Albert W. Hilberg,[23] which appeared in 1955, corroborates these views. In 12 out of 36 cases they were able to

obtain positive identification of tumor cells in postoperative washing from the wound. Local anesthesia is to be avoided as another element that might cause dissemination of cancer cells. Anything adherent to the malignant tumor should be removed along with the tumor, if possible. Remove the lesion and adjacent tissues "en bloc" until a clear zone of normal, uninvolved tissue is obtained. After the removal of the tumor, and prior to beginning of repair and closure of the defect, wash water, gloves and instruments should be changed just as one would in dealing with an infection. Marginal checks by the pathologist during the course of surgery will indicate whether the lesion has been removed, along with a zone of normal tissue. Simple enucleation of a lesion is never adequate.

The present degree of radical surgery that is now practiced with an acceptable mortality rate has been made possible by the many aids to surgical science that are now available. These aids include "scientific" anesthesia, an adequate blood supply for transfusion, and chemotherapy of infections or contamination. One should not hesitate to remove multiple organs, provided he is technically competent, in order to secure palliation or a chance for cure. This is particularly true in lesions of the gastrointestinal tract where one may frequently find a lesion of the colon involving portions of the small intestine, stomach, spleen, kidney, or bladder. In all such instances, one must consider both the physiologic and chronologic age of the patient, the ability to restore him to a usefully functioning life, and the chance of some duration of that life. In other words, there is little to be gained by an heroic operation if one must leave behind so much disease or disability that the remaining period of life is shortened or if the patient is invalided beyond any chance of comfort or satisfaction.

Detailed postoperative care is essential for the successful recovery from the radical procedures that are carried out in an attempt to cure the patient with cancer. Much progress has been made even in the last 5 years in the restoration of the normal physiologic processes following radical surgical procedures. A complete knowledge of this field is necessary, but is beyond the scope of this discussion. Also, surgery of certain particular sites requires a specialized technic in their postoperative care—such as lesions of the head and neck and thorax. It is urged that no surgery of these areas be attempted without the expectation of rendering such postoperative care.

PALLIATIVE SURGICAL PROCEDURES

To those who have much contact with the care of the cancer patient it is becoming increasingly obvious that 5 years is too short a while in which to observe a patient for possible cure for cancer. Follow-up of all treated patients is a requisite of competent therapy. In many different types of lesions we are seeing the disease recur in between 5 and 10 years. In certain of the lesions such as melanoma and cancer of the breast, thyroid, and prostate, we may find the disease remaining with the patient in a fair state of symbiosis for longer than 10 years. Therefore, it is quite probable that we should look on the cancer patient as we do the patient with other diseases that are incurable but for which we can secure a tolerable life, living with his disease. Certainly one does not expect to cure some lesions of the

heart, yet long years of useful life are often afforded such a patient by careful medical attention. We have found the same to be true with the cancer patient and surgery has much to offer in regard to palliating the patient and making life tolerable for long periods of time, even when cure is not a possibility. Often surgical intervention can relieve the patient's distress and actually can change the character of death.

If, from the evidence at hand, a cure is not possible, removal of the primary lesion remains beneficial in many instances. Particularly is this true where the organ involved may become obstructed and its function thus jeopardized, such as with intestine, stomach, esophagus, common bile duct, ureter and larynx. Also, if a slough is imminent, removal of the tumor may prevent a subsequent gross hemorrhage from blood vessel erosion. At times one believes that extirpation of the primary malignant lesion may prevent subsequent metastatic seeding and even result in a less aggressive manifestation of secondary growths. Palliation then also may be more readily achieved by chemotherapy, hormones, or radiation therapy since the mass of tumor to be treated is materially reduced. In summary, palliation is to be attempted if it achieves comfort for the patient and generally is the smallest procedure to achieve the hoped for results—as simple mastectomy in an ulcerated breast which has already metastasized to the lungs, or colostomy for a nonremovable intestinal growth.

Similarly, operations that relieve obstructive jaundice and remove necrotic masses of tumor tissue not only increase the well-being of the patient, but may extend appreciably the length of life. Patients survive months and years instead of weeks, and the terminal stage is of much shorter duration and intensity. Patients for palliative surgical procedures must be carefully selected in order to insure that the physiologic state after surgery is bearable. In addition to the knowledge necessary for the clinical application of the surgical principles, cancer surgery also involves ethical and philosophic considerations.

A surgeon can justify mutilating operations only in instances where there is a worthwhile chance to remove the diseased tissue and preserve the subsequent well-being of the patient. If the operation is so destructive that the patient either dies or becomes a hopeless invalid, there is little justification for such a radical procedure on the slight chance of eradication of the disease. In other words, it must be realized that even the most proficient radical surgery reaches a point of diminishing return insofar as the patient is concerned. Evisceration technics and second-look operations have been devised in an attempt to salvage patients who otherwise are failures from either inadequate or delayed treatment. Each patient must be carefully evaluated as to the possibility of gain against further disability or death.

Other forms of surgical palliation have been attempted in the patient with cancer disseminated from organs the normal growth of which is influenced by various hormones. Huggins[13] influenced this form of investigation and therapy when he practiced removal of the testes in prostatic cancer. At present, adrenalectomy and removal of the pituitary are being tried with varying success in patients in whom cancer of the breast has spread to the skeleton and/or soft tissues.

Pain control by cordotomy, rhizotomy, alcohol injection of the nerves and frontal lobotomy all have their place in making the last days of a person with a hopelessly advanced malignant disease more tolerable. It is worth every effort to delay as a last resort dependency upon narcotics.

COMBINED SURGERY AND RADIATION THERAPY

There are many instances when a better result can be obtained by the use of both radiation therapy and surgery than by either singly. This is particularly true in lesions of the breast, head and neck, lung, body of the uterus, ovary and bladder. It is the practice to follow surgery, which has been performed in instances where the disease has spread to the regional lymphatics or beyond, by some form of radiation therapy. For instance, in cancer of the breast with involvement of the axillary lymph nodes, a postoperative course of x-ray therapy is frequently undertaken. This can be very effective if an adequate cancerocidal dose is given to axillary, supraclavicular and mediastinal areas. Recently a re-evaluation of preoperation radiation therapy with supervoltage beam (million volts plus) has been undertaken in our institution with encouraging results. Dosages similar to those given by McWhirter, of 3,200 to 4,000 r tumor dose or above, have been given prior to performing a radical mastectomy or a patient with axillary metastasis or invasion of skin or underlying muscle. Little difficulty is experienced as regards technic if the surgery is accomplished within 1 month after completion of the irradiation. After this time an increasing amount of fibrosis makes the operation more difficult. With the Cobalt-60 teletherapy unit or Betatron, the skin is spared and primary healing can be expected in the majority of patients.

Team work by the surgeon and radiologist is most fruitful for both palliation and care of many patients with other advanced lesions. Frequently use is made of the "low intensity" radium needles after the "Manchester" technic, or Cobalt-60 or Cesium-137 or Tantalum-182 wire or radioactive gold grains are carefully implanted. These technics are particularly useful in cancer of the tongue, floor of mouth, and salivary glands. Surgery is performed either before or after, depending upon the circumstances. Modern radiation therapy is as different in effectiveness from that practiced before World War II as is modern surgery.

SURGERY FOR CANCER PREVENTION

A discussion of the use of surgery in cancer therapy should include mention of removal of precancerous conditions. This is the only instance where minimal surgery may be used in cancer care. Removal of leukoplakia; polyps (particularly of the colon and rectum); junction nevi located in areas of irritation, such as the perineum and hands and feet; adenocystomas of breast and thyroid; gallstones, abnormal nodules of skin, subcutaneous tissues and "soft parts"; and chronically infected or ulcerated burn scar areas should be considered. Circumcision is one of the best examples of preventive surgery, since cancer of the penis occurs most frequently in those who have not been so treated. Gastric ulcers require removal if unhealed; and patients with pernicious anemia should be carefully followed, because they are more prone than the average person to develop cancer of the

stomach. An undescended testicle has been said to be the site of malignant change 20 times more frequently than a normal testicle.

RECONSTRUCTIVE SURGICAL PROCEDURES

Radical surgical removal of cancer tissue may produce either deformity or dysfunction. Either surgical or prosthetic reconstruction may be necessary. Generally, surgical repair is not attempted until there is reasonable evidence of cure, although some modifications can be incorporated in the definitive surgery that will make repair easier or less extensive. Replacement of destroyed portions of the face and mouth often can be accomplished by transference of tissue or skin grafting. If this cannot be done at the time of surgery, or if the defect is too great to be repaired in this fashion, the construction or application of an artificial appliance can be accomplished with great verisimilitude by modern technics. Rehabilitation, therefore, includes both surgical repair and reconstruction and the use of prostheses.

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BLEEDING MECKEL'S DIVERTICULUM: REPORT OF A CASE OCCURRING IN A SIXTY-SIX YEAR OLD MAN

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In infancy and childhood, Meckel's diverticulum frequently has been reported as a cause of bleeding per rectum, but above the age of 25 it apparently is a rare cause of this condition. The largest series of bleeding Meckel's diverticulum reported to date comes from a center devoted to the treatment of children.[4] Reports emanating from general hospitals also are heavily weighted with cases of patients who are under the age of 15 years. In a collected series from the literature totaling 71 cases[6, 8] in which bleeding was a complication, 97 per cent of the patients were under 25 years of age and 98 per cent were under 50 years of age (fig. 1). Meckel's diverticulum then would appear to be a rare cause of rectal bleeding in elderly individuals. Demonstration of this condition as the etiology of massive rectal bleeding in a 66 year old man prompted the following case report.

CASE REPORT

R. S., a 66 year old white man, was admitted to the Baptist Hospital on Sept. 19, 1955 complaining of profuse rectal hemorrhage. He was well and without complaint until the morning of September 17, when he was awakened by a desire to have a bowel movement. At this time a large amount of liquid and clotted blood was passed per rectum and he experienced weakness and dizziness. He was given several transfusions by his family physician during the next 2 days but the passage of blood per rectum continued. There was no history of nausea or hematemesis. A review of the system was entirely negative. The past history revealed only an appendectomy at the age of 37.

Physical Examination: The patient's admission temperature was 37 C., pulse 88, and blood pressure was 110/70. He was well developed, well nourished and appeared to be acutely ill. His abdomen was slightly distended, but peristalsis was active. There was no abdominal tenderness and the liver, kidneys and spleen were not palpable. Digital rectal examination revealed bright red blood without a palpable lesion. No other pertinent physical findings were present.

Laboratory Data: Examination of the blood revealed a platelet count of 140,000 per cu. cm., erythrocytes 2,600,000 per cu.mm. hemoglobin 8.9 Gm. per 100 cu. cm. and leukocytes 5,800 per cu. mm. with a normal differential.

Prothrombin time, bleeding time, coagulation time and clot formation were within normal limits. The blood urea was 23.8 mg. per cent and the urine was negative.

Course in Hospital: During the first 24 hours of hospitalization he had 10 bloody bowel movements. He was transfused with 2,000 cc. of citrated whole blood. His blood pressure ranged from 90/60 to 120/80 depending upon the rate of intravenous infusion of blood. At the end of 36 hours hospitalization it became necessary to give blood continually in both arms to maintain a blood pressure of 100 Hg systolic. All hope for spontaneous cessation of hemorrhage was abandoned. A Levin tube was passed and aspiration revealed no evidence of blood in the gastric contents. Proctosigmoidoscopic examination at this time revealed blood clots. It was obvious that the hemorrhage arose from the gastrointestinal tract somewhere between the stomach and the floor of the pelvis. Under general anesthesia, 48 hours after hospital admission, an exploratory right paramedian abdominal incision was made.

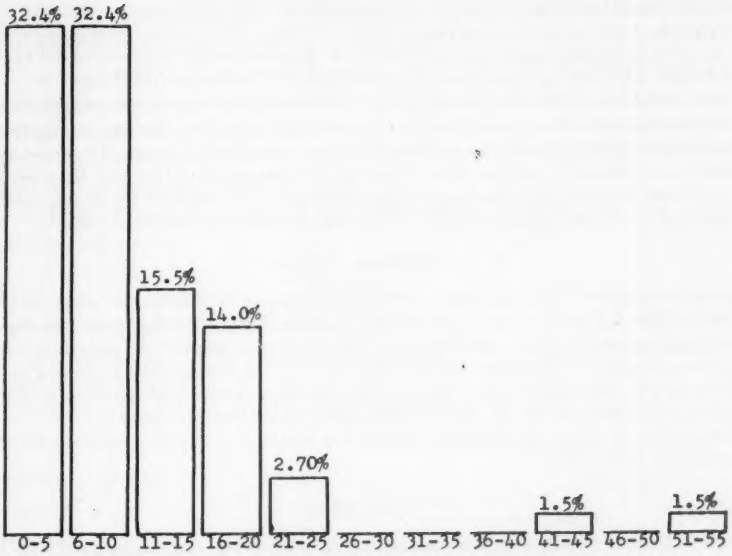

FIG. 1. Age distribution in 71 collected cases of bleeding Meckel's diverticulum

FIG. 2. Photomicrograph showing gastric type mucosal lining of Meckel's diverticulum

The upper small bowel was collapsed and free of blood while the lower small intestine was distended by blood clots. Exploration revealed a Meckel's diverticulum projecting from the antemesenteric surface about 36 inches from the ileocecal valve. It was acutely distended with bright red blood and was about 8 cm. in length with a diameter of 2.5 cm.

The diverticulum was clamped obliquely to the axis of the bowel and removed. Closure of the intestine was effected in 2 layers with continuous catgut on the first and interrupted cotton suture on the second. The abdominal wound was closed in layers. He withstood the procedure satisfactorily and was ambulatory on the first postoperative day. He experienced no additional hypotensive episodes and was discharged from the hospital on the sixth postoperative day. He was asymptomatic at follow-up examination on Oct. 3, 1955.

Pathology Report

Gross Description: This specimen consisted of 2 pieces of tissue, the larger measuring approximately 4.7 by .3 cm., and an everted surface apparently represents mucosa. The second portion consisted of a small tubular piece of tissue open at both ends measuring 1.5 cm. in length and 1.7 in diameter. Gross examination of the mucosa failed to reveal an ulcer.

Microscopic Description. This Meckel's diverticulum shows large areas to be lined by definite gastric mucosa (fig. 2). An area of mucosal ulceration also is seen.

Diagnosis. Meckel's diverticulum containing large portions of gastric mucosa with ulceration.

DISCUSSION

Meckel's diverticulum is the vestigial remnant of the omphalomesenteric duct. Normally this structure undergoes complete obliteration during the seventh week of embryonic life, but the entire duct or segments of it may persist. When the portion in juxtaposition to the ileum remains it is called a Meckel's diverticulum.

Invariably, hemorrhage, when it occurs, has been found to arise from acid peptic ulceration of the neck of the diverticulum or the adjacent ileal mucosa. The source of these ulcerating secretions is thought to be the ectopic gastric mucosa so frequently demonstrated to line these diverticula. In 14 cases collected from the literature demonstrating ectopic pancreatic tissue, none were associated with bleeding.[5] The first to propose a theory to explain the occurrence of ectopic mucosal elements in Meckel's diverticulum was Albrecht[1] who maintained that the entoderm lining the primitive intestinal tube possesses the potentiality of developing into any of the glandular components of the fully developed gastrointestinal tract. Schaetz[7] proposed that during early embryonic life there may be a transference of cells lining the premature intestinal tube, due to the rotating movements of the embryo, with reimplantation of these cells at narrowed points of the intestinal tract. Farr and Penke[2] advanced the theory that the omphalomesenteric duct originally may have had a digestive function and hence embodies a complete primitive digestive system. Greenblatt[3] agreed but carried the theory one step further to suggest that while normally this embryonic system regresses as soon as its function ceases, occasionally a vestige of heterotopic tissue remains as a consequence of retarded embryologic retrogression. Certainly the nutritive elements which are found within the early yoke sack are assimilated by the embryo and we are forced to agree that these elements certainly must be acted upon by the cells of the vitelline duct in some manner analogous to passage of food through the upper digestive tract before it is absorbed by the cells of the jejunum and ileum.

Meckel's diverticulum must be considered in any patient presenting evidence of lower gastrointestinal hemorrhage regardless of age. Males are affected 3 times more frequently (75 per cent) than females.[6, 8] On rare occasions there may be a complaint of crampy abdominal pain due to sudden distention from massive hemorrhage. Physical examination usually is negative and roentgenography rarely is helpful in establishing the presence of Meckel's diverticulum. In fact, the diagnosis seldom is made before surgery.

The technic of surgical removal has been amply presented in the current surgical literature.[9]

SUMMARY

A case of bleeding Meckel's diverticulum in a 66 year old man is presented.

Theories explaining the presence of ectopic gastrointestinal tissue in Meckel's diverticulum are reviewed.

Although bleeding Meckel's diverticulum is more frequent in the young, it may be found at any age.

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ACUTE INTESTINAL OBSTRUCTION: PLAN OF MANAGEMENT

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In the management of a case of acute intestinal obstruction, the possibility of strangulation and the presence of distention determine the order of procedure in diagnostic and therapeutic measures. In this day of accurate diagnostic methods the tendency is to consider diagnosis of first importance and to proceed in an orderly manner to that end. In acute intestinal obstruction an attempt to determine the causative factor commonly must be deferred if the welfare of the patient is not to be unduly jeopardized.

Of immediate concern is the question of compromise of the blood supply to a segment of bowel. Relief of distention by gastric suction, intravenous administration of fluids and electrolytes and antibiotic therapy should be started at once, but laboratory procedures should be limited to the examination of the blood and urine, and roentgenogram of the abdomen without contrast medium. The decision is one chiefly of clinical judgment. Unless the presence of strangulation can be almost certainly ruled out, operation is urgently indicated as changes take place rapidly in the involved loop. One must be on guard not to be misled by the clinical improvement following suction decompression of the stomach and intestine proximal to the obstruction. Although apparently ruled out at the time, compromise of the blood supply cannot be completely dismissed from mind until after the obstruction has been relieved.

Abdominal distention is the consideration of next importance. Its presence limits the use of diagnostic procedures both from the standpoint of safety and effectiveness. Proctoscopic examination gives little, if any, information not acquired by the examining finger. It is a tax on the strength and the cardiorespiratory system to place the patient in the inverted position necessary for a satisfactory examination. Manipulation of the instrument beyond the rectal ampulla is difficult and attended by risk of perforation and injury to adherent distended loops by pressure upon them. Barium by mouth for roentgenologic examination is seldom of value and generally harmful, especially if operation becomes necessary. Furthermore it occludes tubes used for gastrointestinal suction. In distention of more than moderate degree barium cannot be satisfactorily injected by rectum. Any barium injected may not be expelled but remains to give trouble in various ways. Plain roentgenologic examination of the abdomen in the supine and upright positions gives valuable information as to the site of obstruction and the degree of distention. It should be repeated at intervals during the course of the illness. It is the laboratory procedure of greatest value, and is not attended by risk.

Efforts should be directed toward relief of the distention. Enemas are seldom

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of value and if retained add to the distention. Chief reliance is placed upon gastrointestinal suction intubation. Should relief not be obtained after an arbitrary period of 6 hours, operation is advisable. The number of patients who obtain relief after this period is very small, and those not relieved become increasingly poor operative risks. At operation for small bowel obstruction, where the bowel is heavy and the walls edematous, and where distention prevents ready access to the site of obstruction, the bowel should be emptied by enterotomy so as to avoid damage by manipulation.

In large bowel obstruction not relieved after a reasonable period of time, a colostomy or cecostomy should be performed, depending upon the site of the obstruction and any subsequent operation which may be thought necessary for definitive treatment. Where distention is pronounced and the bowel difficult to mobilize, preliminary partial decompression by needle aspiration may be necessary to reduce the danger of injury to the bowel attendant upon manipulation.

Only after distention has been relieved and a reasonable degree of homeostasis obtained, can primarily attention be paid to establishing a diagnosis as to the cause of the obstruction. While not always possible, it is advisable to exert every reasonable effort to obtain a diagnosis before proceeding with operation as a definitive measure.

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INTUSSUSCEPTION IN THE NEWBORN INFANT: A CASE REPORT

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Vomiting in the newborn infant presents a diagnostic problem for the pediatrician. The possibilities include congenital hypertrophic pyloric stenosis, intestinal stenosis, intestinal atresia, meconium ileus, intra-abdominal hernia, intestinal malrotation, and intussusception. Intussusception is found most frequently in males during the ages 4 to 18 months, and therefore is rarely considered as a cause of vomiting in the first month of life. In our review of 130 patients with intussusception the sex incidence was 2 to 1 in favor of the male up to the age of 10 years, after which the ratio was 1 to 1. In an exhaustive study of the literature of the past 150 years, Rachelson and co-workers[1] found only 28 reported cases or an incidence of 0.3 per cent occurring during the first month of life in a total of 5,966 patients with intussusception. They add an additional case to the literature from their records.

They report an interesting case of the passage of a segment of gangrenous tissue through the rectum of a female infant 30 hours of age. Subsequently, this patient developed complete intestinal obstruction which required surgical correction and resulted in a cure. In their analysis of the 28 cases, they found treatment described in only 10 instances. Six of these 10 patients underwent surgery. Two had simple reduction alone, and 4 had intestinal resection and anastomosis. The 4 patients treated nonsurgically died. One of the patients treated with resection and anastomosis survived.

We would like to present the thirtieth recorded incidence of intussusception in the newborn.

CASE REPORT

A. J., a newborn male infant, was delivered spontaneously at full term after a normal labor to a para 2, gravida 2, mother. The baby weighed 6 lbs. and 6 ozs. at birth.

He progressed satisfactorily for the first 48 hours of life then began to vomit small amounts of bile stained fluid. Following each episode of vomiting there was a short period of quiescence during which time there was no evidence of abdominal pain. He was started on milk formula and took each feeding as if he were hungry, but shortly thereafter would vomit up the entire amount taken. The vomiting persisted and became projectile in character.

Physical findings on the first day of life were normal. During the third day, he developed mild upper abdominal distention. On palpation no abdominal mass could be found. A small swallow of thin barium was given, and roentgenograms revealed an obstruction about 10 inches below the ligament of Treitz. Repeat roentgenograms after several hours and again after 24 hours showed no progression of the barium (fig. 1).

His hemoglobin at this time was 16.2 grams. Hydration was obtained by intravenous infusion of 5 per cent glucose in water through a polyethylene catheter inserted into the saphenous vein. On the fifth day after birth a laparotomy was performed under general

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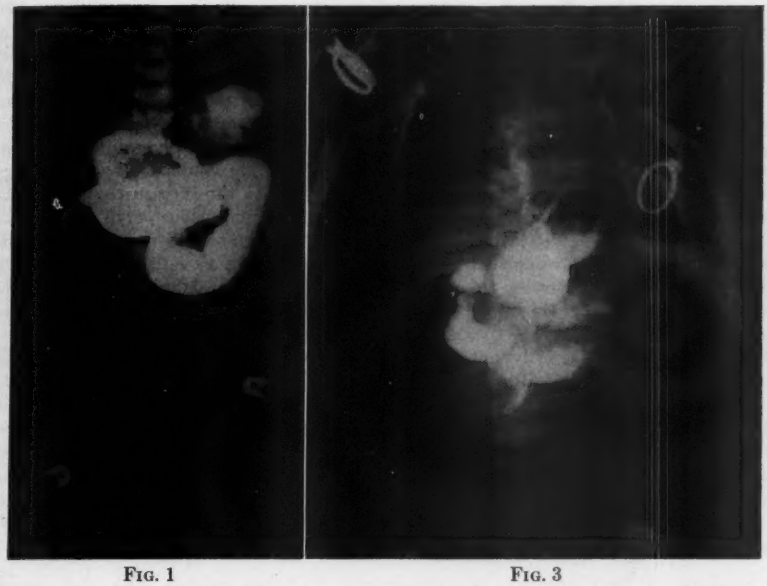

FIG. 1 FIG. 3

FIG. 1. Radiologic findings prior to first operation. Note point of obstruction in right flank.

FIG. 3. Radiologic findings prior to second operation. Note point of obstruction opposite third lumbar vertebra.

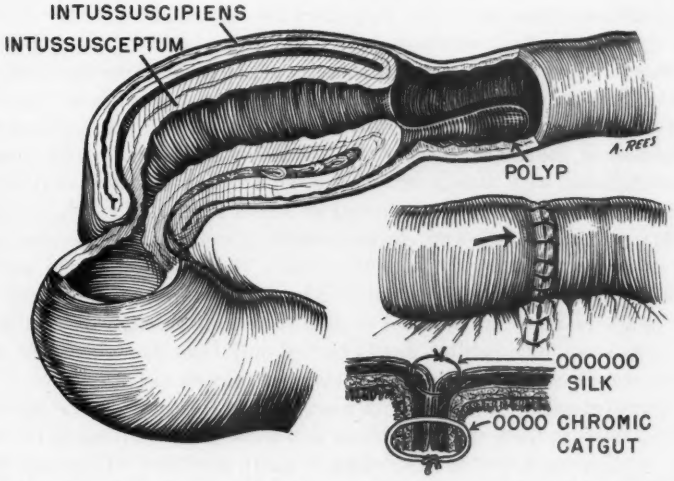

FIG. 2. Diagrammatic drawing of pathology found at surgery in the reported case and method of anastomosis after resection.

anesthesia (drop ether). The abdomen was explored through a midline abdominal incision. The jejunum was found to be distended for a distance of 10 inches below the ligament of Treitz at which point there was an intussusception which could not be reduced. The mass measured 7 cm. in length and 3 cm. in diameter. It was dark red in color and covered with fibrinous exudate. A resection was done and the continuity of the intestine re-established by an end to end anastomosis. Individual sutures of No. 0000 chromic catgut were used for the inside layer of sutures and No. 000000 arterial silk on an atraumatic needle for the outside layer of sutures. The pathologic specimen was opened and examined. The intussusceptum measured 6 cm. in length and was densely adherent to the intussuscipiens. At the presenting end of the intussusceptum there was a partially gangrenous polyp which measured 2.5 by 1 cm. There is little doubt that peristaltic traction on this tumor was the precipitating factor in the development of the intussusception (fig. 2).

The patient rapidly recovered from surgery and was started on formula feedings on the fourth postoperative day. He gained weight and was discharged from the hospital on the eleventh postoperative day.

He progressed satisfactorily until the twenty-fourth postoperative day when again there was the onset of projectile vomiting of bile stained fluid. He was readmitted to the hospital with a diagnosis of intestinal obstruction.

Roentgenograms with a small swallow of thin barium showed jejunal obstruction below the point of anastomosis (fig. 3). At laparotomy, 3 dense bands of adhesions were divided and the obstruction relieved. The bowel appeared almost normal at the site of the previous anastomosis. He recovered rapidly, and was discharged from the hospital 5 days after operation. There have been no further signs of intestinal obstruction, and he has gained weight in a normal manner since discharge.

Comment: After correction of dehydration in these infants, the abdomen is prepared with ether and tincture of zephrin. The necrotic remnant of the cord is a definite hazard in those children over 24 hours of age and should be excluded from the field of surgery to prevent peritoneal contamination. A midline or paramedian abdominal incision is made under ether anesthesia. The cause of the intestinal obstruction is readily found on exploration of the abdominal cavity, and appropriate steps are taken to correct the abnormality. Other abdominal pathology should not be overlooked. In some instances of intussusception, simple reduction alone is necessary. In those patients with irreducible intussusception resection and anastomosis must be done. In the reconstitution of the continuity of the intestine after resection a single layer of silk sutures is used when the diameter of the distal segment of intestine is small. This occurs most often in those patients with atresia or stenosis. In most cases, however, 2 layers of sutures should be used. We recommend an inside layer of through and through individual sutures of No. 0000 chromic catgut placed near the severed margins of the intestine and 4 to 5 millimeters apart. The outside layer is made with No. 000000 arterial silk on an atraumatic needle. The sutures are placed 3 millimeters apart, and care is taken not to pass the needle through the full thickness of the bowel wall. The sutures should be tied only tight enough to just approximate the serosal surfaces. One must remember that edema always occurs at the site of anastomosis after resection of a segment of intestine. If the anastomosis is made carelessly, there may be leakage and subsequent peritonitis. If too much margin is rolled in, a partial diaphragm is easily produced which may result in further obstruction. Because the diameter of the intestine of the newborn is so small, the latter is a definite possibility.

Gastric suction is maintained for a few days following surgery. Parental administration of fluids is continued until the patient is able to take food by mouth. Antibiotics are given before surgery and for 4 to 5 days after surgery.

SUMMARY

A report is given of an intussusception of the jejunum in a newborn infant which required resection and anastomosis. Because there was postoperative obstruction re-exploration and lysis of adhesions was done with complete recovery of the patient. A few important points are emphasized in the technic of intestinal surgery in infants. This case represents the thirtieth recorded instance of intussusception occurring during the newborn period (1 month).

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ACUTE APPENDICITIS: ANALYSIS OF THREE HUNDRED AND EIGHTY-SEVEN CASES

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The mortality figures for acute appendicitis have shown a striking decline in the past 3 decades. McLanahan stated that the mortality per 100,000 population dropped from 17 deaths in 1929 to less than 3 in 1948[6], and in 1954 this was further reduced to 1.4[10]—reflecting improvements in the management of complications of this disease. Yet appendicitis remains one of the most common serious problems with which the surgeon must deal, and periodic objective reviews of our experience, with proper evaluation of therapy, are in order if this improvement is to continue.

The following report is based upon a study of all patients operated upon for acute appendicitis at the Veterans Administration Hospital, Houston, Texas from June 1949 through March 1956. Attention is directed particularly to accuracy in diagnosis, complications, and mortality. To evaluate our results better they were compared with a larger group compiled from the literature, selecting reports for the same period when modern therapeutic agents were available.

DIAGNOSIS

The diagnosis of acute appendicitis must be based upon the history and the physical findings for there are no specific diagnostic aids which allow a differentiation from other acute abdominal processes. Furthermore, many nonsurgical conditions may produce physical findings indistinguishable from this disease. Renal colic, right lower lobe pneumonia, salpingitis, and gastroenteritis are a few of the commonly encountered nonsurgical problems which may produce a confusing clinical picture. Consequently, it is generally agreed that an absolute diagnosis of appendicitis is not possible, and every conscientious surgeon will occasionally explore the abdomen with a preoperative diagnosis of acute appendicitis only to find that there is no discernible intra-abdominal pathology. The postoperative course of such patients is usually quite benign, and operative intervention is indicated when a high suspicion of appendicitis exists. However, the decision to operate should be made only after careful evaluation of the patient and a serious effort to exclude other disease processes. It is generally conceded that a diagnostic accuracy of 75 to 85 per cent is desirable.

In this series 492 patients were explored with a preoperative diagnosis of acute appendicitis, 78 (15.8 per cent) of whom had no abnormal abdominal findings at operation (table I). A definite etiologic diagnosis was never made in the majority of these patients, although 2 were later proved to have had pneumonia and a third had diabetic acidosis. There was one patient with amebic colitis,

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TABLE I

Diagnosis of Acute Appendicitis

	Veterans Administration Hospital		Collected Series	
	No. cases	Per cent	No. cases	Per cent
Error (other acute intra-abdominal diseases)	23	4.8	213	6.8
Error (no acute intra-abdominal disease)	82	16.5	516	16.6
Total error	105	21.3	729	23.4
Correct diagnosis	387	78.7	2380	76.6
Total cases	492	100.0	3109	100.0

TABLE II

Diagnostic errors

Other intra-abdominal diseases	
Perforated ulcer	6
Ileitis	4
Sigmoid diverticulitis	2
Cecal diverticulitis	2
Omental infarction	2
Abdominal abscess	2
Cholecystitis	1
Pancreatitis	1
Meckel's diverticulitis	1
Leiomyoma jejunum	1
Mesenteric thrombosis	1
Total	23

one with colitis of undetermined origin, one with endometriosis, and one with a ruptured ovarian follicle, totaling 4 patients (0.8 per cent), who had nonsurgical intra-abdominal diseases. Last, there were 23 patients (4.8 per cent) who had other acute abdominal diseases which simulated appendicitis and in whom surgical intervention was indicated although the exact diagnosis was not made preoperatively. It is of interest that nearly one-third of these processes originated in the upper abdomen, perforated ulcer being the most common. Other more unusual lesions were also encountered including 2 patients with omental infarct, 2 with cecal diverticulitis, and one with a tumor of the small bowel (table II).

TREATMENT

Immediate appendectomy has been the accepted treatment for simple acute appendicitis since the disease was first recognized. However, there has been considerable disagreement as to the best management of appendicitis with perforation. In those patients in whom there is evidence of localization, nonoperative management has been preferred by some since the inflammation may subside,

TABLE III

Complications following appendectomy for acute appendicitis

	Simple Acute		Perforated	
	No. cases	Per cent	No. cases	Per cent
Wound infection	17	5.4	8	10.9
Wound seroma	—		2	2.7
Wound hematoma	1	.3	—	
Wound separation	1	.3	—	
Evisceration	—		2	2.7
Fecal fistula	—		2	2.7
Ileus	4	1.3	4	5.4
Atelectasis	3	1.0	2	2.7
Intestinal obstruction	2	.7	1	1.3
Pelvic abscess	—		2	2.7
Retained fecalith	—		1	1.3
Mesenteric hematoma	1	.3	—	
Pulmonary infarction	1	.3	—	
Postoperative psychosis	1	.3	—	
Delirium tremens	1	.3	—	
Penicillin reaction	1	.3	—	
Urinary tract infection	1	.3	1	1.3
Phlebothrombosis	1	.3	—	
Total	35	11.1	25	33.7

and the same program has been advocated for patients with diffuse peritonitis. Currently, most surgeons advocate removal of the appendix as soon as the patient has been adequately prepared for operation regardless of the stage of the disease. Correction of fluid and electrolyte deficit, relief of intestinal distention, the use of antibiotics and blood transfusions should be utilized as indicated both before and after operation.

With 2 exceptions we performed immediate appendectomy once the diagnosis was made. In both patients there was perforation with abscess formation, and the appendix was not accessible at the initial exploration. Drainage was done in each instance, and one patient had an interval appendectomy 6 weeks later. The second patient refused further surgery but was later readmitted with recurrent appendicitis with perforation and generalized peritonitis. Emergency appendectomy was done; recovery followed, after a protracted convalescence marked by several complications. This patient emphasizes the necessity for interval appendectomy within 4 to 6 weeks after drainage of an abscess to obviate reperforation.

COMPLICATIONS

In this series the incidence of complications was 3 times greater in patients with perforation than in those without, and evisceration, fecal fistula, and pelvic abscess were associated only with perforated appendicitis. The over-all incidence of complications for both simple acute and perforated appendicitis was

TABLE IV
Operative mortality

Appendicitis	Veterans Administration Hospital			Collected Series		
	Total cases	Deaths		Total cases	Deaths	
		No. cases	Per cent		No. cases	Per cent
Simple acute	313	1	0.3	3909	5	0.11
Perforated	74	3	4.1	945	30	3.2
Over-all mortality	387	4	1.0	4854	35	0.7

15.5 per cent (table III). In the past, appendicitis has been listed as the most common cause of fecal fistula, but in our experience this has been rare and less of a problem than fecal fistula from other diseases such as diverticulitis or carcinoma of the colon. Pylephlebitis was not encountered. There was only one complication (a wound seroma) in the 82 patients in whom the exploration revealed no acute abdominal disease.

MORTALITY

The mortality from simple acute appendicitis has been well below 1 per cent ever since appendectomy became the standard treatment. The mortality from perforated appendicitis, however, was quite high 2 decades ago—approximately 20 per cent[2]. There has been a progressive decrease in mortality until it is now in the range of 3 per cent and some clinics have reported large series of cases with no mortality at all (table IV).[1, 2, 4, 5, 6, 7, 8] Factors important in the reduction of mortality include the use of intestinal decompression, intravenous fluids, whole blood and antibiotics.

There were 4 deaths in this series, an over-all mortality of 1 per cent. Only one death occurred in a patient treated for simple acute appendicitis. This man was a chronic alcoholic addict who postoperatively developed a wound infection with partial separation. Following secondary closure he became jaundiced and developed acute liver failure from which he never recovered. The remaining 3 deaths occurred in patients with perforated appendicitis, one of whom developed cardiac arrest during operation. He was resuscitated but had sustained severe cerebral damage and remained in a coma until death occurred 9 days postoperatively. The remaining 2 patients were both elderly men who had hypertensive cardiovascular disease and who were being treated with ganglionic blocking agents. Initially, the complaint of abdominal pain was attributed to side effects from the hypotensive agent, and the patients were not seen by the Surgical Service until after perforation had occurred. One patient developed irreversible shock after the induction of anesthesia from which he never recovered, and the second developed anuria and died 2 days postoperatively. It is believed that the hypotensive agents were direct contributing causes in the death of these 2 patients not only because their use resulted in a delay in diagnosis, but also be-

cause it is likely that they contributed to the fatal postoperative complications. Some patients being treated in this manner develop periods of hypotension without any other precipitating cause. When one adds anesthetic agents and an operative procedure, which also may produce a fall in blood pressure, it is not difficult to understand how the combination of these factors may result in irreversible shock and renal failure.

There were no deaths among the 82 patients who had no acute abdominal disease.

DISCUSSION

During the past decade, many agencies have engaged in an attempt to educate the general public concerning the significance of acute abdominal pain and the danger of the ingestion of laxatives when such symptoms appear. This has been done to encourage the patient to consult a physician early in the course of acute abdominal disease, thereby allowing diagnosis before appendiceal rupture occurs. However, the issue has been clouded somewhat by occasional articles advocating nonoperative treatment of appendicitis with antibiotics[3] and it is possible that this is partly responsible for the fact that the incidence of perforated appendicitis is essentially the same today as it was 20 years ago. In our series, 20 per cent of the patients were found to have perforation at the time surgery was performed, and the reduction in mortality has resulted from the numerous adjuncts in surgical therapy which have become available for the management of intra-abdominal complications of appendiceal disease rather than to earlier diagnosis. It is true that a reduction in the mortality from appendicitis can be obtained both experimentally and clinically by the use of antibiotics alone, and they have contributed significantly to the actual reduction in mortality which has occurred. However, the use of antibiotics does not prevent perforation of a diseased appendix.[9] Furthermore, it is a well-established clinical observation that appendicitis which responds to any conservative program is likely to recur. This point was well demonstrated by one of our patients whose case is reported herein. Therefore, the danger of a recurrent attack always persists, and a nonoperative approach to the problem is to be deplored. The best method for keeping the mortality and morbidity at a minimum is by surgical intervention before perforation occurs, and continued attempts at public education should be made.

SUMMARY

Four hundred and ninety-two patients were explored with a preoperative diagnosis of acute appendicitis, and a correct diagnosis of acute appendicitis was made in 78.7 per cent. Twenty-three (4.8 per cent) of the diagnostic errors were due to other acute intra-abdominal diseases requiring operation which simulated appendicitis while 82 patients (16.5 per cent) had no acute intra-abdominal disease. Immediate appendectomy is advocated as the treatment of choice. The incidence of complications was 11.2 per cent in patients with simple acute appendicitis and 33.8 per cent in patients with perforated appendicitis. There was

an over-all mortality rate of 1 per cent, being 0.3 per cent in patients with simple acute appendicitis and 4.1 per cent in the group with perforated appendicitis.

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THE USE OF CUTIS GRAFTS FOR REPAIR OF HERNIAS AND ITS USE IN RECONSTRUCTIVE PROCEDURES

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INTRODUCTION

Various materials have been used in reconstructive surgery. These materials have been advocated, mainly, in the repair of larger hernias; but there have also been numerous reports on the use of these materials in orthopedic, vascular, and plastic surgical procedures.

Recent review of the literature reveals many materials to be in "surgical vogue", including fascia, skin, metals, and various plastic materials (fig. 1).

This compilation, although probably incomplete, gives some idea of the wide variety of materials used. Logical deductions would lead to the conclusion that no one material is entirely satisfactory or applicable in every instance. It is not the purpose of this paper to discuss the merits and demerits of these various materials, but certain comparisons will be necessary. Our intention is to discuss the indications and uses of cutis (dermal) grafts in reconstructive surgery, with emphasis on its use in the repair of abdominal wall defects, and to present certain other uses which have been less emphasized. Ideas and suggestions in the use of cutis grafts are to be presented.

DEFINITION

Cutis graft is an excised area of skin, from which the epidermal layer has been removed and used as a graft in another region of the body. The terms cutis graft and dermal graft are synonomous.

HISTORIC REVIEW

Cutis grafts were first introduced by Otto Loewe[5], a German surgeon, in 1913. Edouard Rehn[5] used this material at the same time. Cutis grafts were first used in this country in 1934, by Dr. John E. Cannaday[5], who published his first article in the American literature in 1942. While working with Cannaday, the usefullness of cutis graft was impressed upon one of the authors (A. R. McC). Fomon[5], Uihlen[64], May[39], Davis[5], Byars[5], Peer and Paddock[47], Harkins[19, 20], Mair[35, 36, 37], Shaffer[52], and others have worked and written extensively on this subject.

HEALING AND FATE OF CUTIS GRAFT

Rehn and Schwartz[5], and Peer and Paddock[47] were the first to investigate, histologically, the healing and fate of cutis grafts. Later, Harkins[19] carried out

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Materials implanted in man

I. Fascia—(sutures, patches, and flaps)[54, 55]
   1. Autograft (Fresh)[17, 21, 22, 28, 31]
   2. Homograft (Lipolysed)[65]
   3. Heterograft (Ox-prepared)[25, 65]

II. Skin—(sutures and patch grafts)
   1. Full thickness skin (Autograft; homograft-frozen)[3, 11, 14, 35, 36, 37, 50, 52, 62]
   2. Cutis (or dermal) (Autograft)[5, 6, 7, 8, 9, 19, 20, 47, 52, 61, 62]

III. Metallic—(sutures, mesh, plates, etc.)[1, 2, 34]
   1. Silver (sutures, mesh, plates)[12]
   2. Steel (sutures and mesh)[49, 57]
   3. Tantalum (sutures and mesh)[13, 15, 23, 24, 25, 26, 29, 36, 41, 56, 57]
   4. Vitallium (plates)[34]

IV. Plastic—(sutures, mesh, plates, cloth, sheets, sponges)[28, 45]
   1. Acrylic (plates)[32]
   2. Polyvinyl (sponges)[51]
   3. Glass (mesh)[32]
   4. Fortisan (fabric)[45]
   5. Nylon (sutures and mesh)[58]
   6. Vinyon (tubes)[66]
   7. Polythene (ligatures and sheets)[32]
   8. Telflon[32]

V. Combinations—skin and tantalum[10]

VI. Others—diced homologous cartilage[53]

FIG. 1

Healing and fate of cutis graft[19, 47, 50, 52, 62]

1. Exudation—serum collection limited by tension.
2. Nutrition—lymph first—blood supply later.
3. Necrosis—epithelial elements.
   (a) Sebaceous glands—early.
   (b) Hair follicles—early.
   (c) Sweat glands—late.
4. Fusion—with adjacent tissues.
5. Remaining cutis—fibrous metaplasia.
6. Living fascial patch

FIG. 2

similar investigations. Recent reports of work carried out by Shaffer[52] confirm these findings (fig. 2).

Shaffer revealed that cutis graft unites more easily and readily than whole skin. Exudation occurs in 24 hours, increasing to a maximum in 1 week, and decreasing after this time.

Where cutis was sutured under tension, exudation was found to be minimal. Necrosis of the epithelial elements, in cutis graft under tension, began in the first 24 hours, continued for 2 weeks, and was found complete after 3 months. Shaffer found that cutis should be sutured under tension for these phenomena to occur. He concluded that the nutrition of these grafts, first, comes from the surrounding lymph, and by suturing the graft under tension the lymph spaces become closed. Specialized epithelial elements, requiring greater nutrition, thereby undergo necrosis. The collagen bundles survive and provide a firm, living, connective tissue patch at the site of the graft. It was found that no gross

or microscopic cysts occurred in cutis grafts sutured under tension. However, gross cysts of whole skin grafts occurred in 80 per cent not sutured under tension, in only 45 per cent when sutured under tension. Studies on tensile strength reveal that 90 per cent of the tensile strength of skin lies in the cutis. Reduction in tensile strength was found to occur within the first 3 weeks where the graft was sutured under tension, increasing after this period. After 6 weeks, cutis sutured under tension was stronger than whole skin under tension or cutis sutured without tension. It was also found that cutis grafts exhibit superior tensile strength when compared to fascia lata, in both the horizontal and vertical planes. In one instance, previously inserted cutis graft showed no marked decrease in tensile strength 11 days postoperatively, thereby demonstrating the continued strength which cutis grafts afford.

USES OF CUTIS GRAFT

The use of cutis graft in the repair of large hernial defects has been emphasized, but numerous other conditions have been found in which its use has been reported as satisfactory.

Cannaday[5, 6, 7, 8, 9] has reported the successful use of cutis graft in various conditions, including repair of cranial defects, as well as in tissue defects of various areas of the body surface; in suspension of organs, such as the uterus and kidney; in various orthopedic conditions, such as chronic recurrent dislocations of the shoulder, coracoclavicular and acromioclavicular, and sternoclavicular dislocations. Cannaday has also reported its successful use in orthoplasties of the temporomandibular, knee, and shoulder joints. Also, it has been used in lieu of Parham's bands to bind oblique fractures of the femur and humerus; to repair fractures of the patella; for reconstruction of the cruciate, as well as the external, ligaments of the knee; for elimination of depressions of surface contour; for replacement of resected pleura in cases of advanced cancer of the breast, as well as replacement of the peritoneum or aponeurotic tissues. Cannaday also reported on the use of cutis graft for the ligation of major arteries, such as the aorta, femoral, and internal and external carotid arteries. In addition, it has

Uses of cutis graft

A. General uses
   Any condition where fascia has been advocated.[6, 7, 8, 19, 31, 61, 64]
B. Specific uses
   1. Hernias—ventral, incisional, recurrent inguinal, lumbar and diaphragmatic[5, 6, 7, 8, 9, 19, 52]
   2. Tissue defects—dural, pleural, nasal, abdominal wall, tracheal, bronchial, tendons[5, 6, 7, 8, 9, 39, 42, 43, 44]
   3. Suspension of organs—uterus, cervic, kidney, rectum, colostomy, bladder[5, 6, 7, 8, 9, 40]
   4. Bone and joint—fractures, various dislocations and separations[5, 6, 7, 8, 9]
   5. Vascular—ligation of arteries, reinforcement of arterial aneurysms[8, 9, 33]
   6. Joints—restoration of knee, temporomandibular and acromioclavicular joints[8, 9]
   7. Ligaments—knee, ankle, shoulder, acromioclavicular, etc.[8, 9]

FIG. 3

been used as a substitute for fascia lata in the operation devised by Orr for prolapse of the rectum, and has also been used for the repair of hernias of colostomies; likewise, it has been used in the Harvey Stone type of operation for rectal incontinence. Lowenberg[33] reported its use in 2 cases of aortic aneurysm.

In addition to its uses in hernial defects of various types and primary closure of wounds, where the tissues are poor, we have employed it in the repair of acromioclavicular and coracoacromial separations, instead of fascia, by the method of Bunnell[4], with satisfactory results. It was used to reinforce a fusiform aneurysm of the innominate artery in one patient. Also, it was employed satisfactorily in the repair of 3 recurrent cystoceles of marked degree. Paulson[42, 43, 44] reported the successful use of cutis in the repair of a traumatic rupture of the main stem bronchus. Cutis grafts have also been used in the repair of the trachea, where portions of this structure have been resected in radical neck dissections for malignancy. Numerous other uses have been reported in addition to these.

INDICATIONS AND CONTRAINDICATIONS

Certain large and difficult hernias are encountered which cannot be repaired satisfactorily by use of adjacent anatomic structures. In many of these, additional reinforcement is necessary for cure and, here, cutis graft finds its greatest usefulness. In the more commonly encountered types of hernias, namely, uncomplicated inguinal, femoral, and umbilical hernias, reinforcement is rarely required.[18, 20, 22, 23, 38, 48, 59, 60] However, in large ventral hernias, umbilical, paraumbilical, and incisional types, and in certain recurrent inguinal hernias, reinforcement may be required. In these instances, cutis has been found to be a most satisfactory material.

Tantalum or stainless steel mesh is believed to be more satisfactory than cutis graft in the presence of infection, actual or potential; impaired vascularity of the tissues, as in postirradiation defects; disturbed tissue healing, as in acute wound disruption, dehiscence, upper intestinal or pancreatic fistulas; or in resection of large areas for malignancy, especially of the abdominal wall.

MERITS OF CUTIS GRAFT

Cutis, for grafting, is easily obtained in any quantity, size, or shape needed. It is always available, requiring no advance procurement. It is easily handled. It is exceedingly strong in all directions, and maintains its tensile strength even in the preliminary healing phase. Cutis graft should be sutured under tension, which aids in reinforcement and splinting of the adjacent structures. Cutis grafts "take" more readily than fascial grafts and cause less complications than whole thickness skin grafts. It becomes a living connective tissue replacement. Cutis graft may be used in several thicknesses in the various layers of the abdominal wall. Where preliminary closure is not feasible or the cutis is not removed from redundant skin over the hernial defect, the donor site is easily grafted with the epidermal layer, causing no appreciable deformity or disability.

Fragmentation of tantalum occurs frequently.[56] Although in most instances of

lower abdominal hernial repair this does not lead to recurrence, fragmentation leads to recurrence in upper abdominal hernial repair.[56] Erosion through the peritoneum by tantalum and other metallic mesh has been reported.[56] Infection in clean wounds has been practically nil since the antibiotic era, and presents no major problem or contraindication in the use of cutis.

TECHNIC OF THE USE OF CUTIS GRAFT

The general principles of preoperative preparation, where possible, should be followed, such as weight reduction and correction of deficiencies due to chronic diseases and nutrition, as well as other factors which may adversely influence healing.

The technic for the use of cutis graft, as used by the authors, is essentially that as advocated by Cannaday[5]. Cutis may be obtained from several sites, namely, excess skin over the hernial sac or site, adjacent skin, or from a distant site, such as the anterior thigh. Local preparation is the same as for the operative site, namely, shaving the skin, washing with surgical soap, and followed by aqueous zephiran chloride solution.

The tissue defect, or hernia, is repaired as completely as possible with available adjacent structures. Reinforcement with one or more layers of cutis graft is performed.

The cutis is secured by removing first the epidermis, as one does in removing a thin split thickness skin graft. Numerous methods have been devised and reported in the literature. The Blair-Brown knife[5] or the Brown electric dermatome[61] are usually used by the authors to remove the epidermis, but a straight razor or razor blade have been used on occasions. The underlying cutis is then removed with the scalpel, with the least amount of adherent subcutaneous fat as feasible. A small amount of fat has not, in our experience, interfered with a successful take of the cutis graft, nor has this been reported by others as detrimental to healing.

The secured cutis graft is then sutured over the fascial defect, with a suitable overlap, so as to secure it to strong, viable fascia, tendon, ligament or periosteum. Interrupted nonabsorbable sutures are best suited for this purpose, and the graft should be sutured under considerable amount of tension. Cotton sutures have been used most often for this purpose on our patients, but silk and wire have been used on occasions. Frequently, additional sutures are taken in the inner portion of the graft to secure it to the underlying structures, to preclude the collection of serum beneath the graft. Puncture wounds, so-called "pie-crusting", are seldom necessary, but may be used in the larger grafts. Drainage, via separate lateral stab wounds, with Penrose rubber drains for 48-72 hours is routinely used on large incisional hernias, and a pressure dressing employed to minimize the collection of serum in the wound.[29] On occasions, especially in incisional hernias and in previous rectus muscle splitting incisions in the upper abdomen, a cutis graft has been used on the posterior rectus sheath as well as on the anterior rectus sheath. The donor site, where small, and the skin loose, frequently may be closed primarily. Where primary closure is not

feasible, the wound is covered with the epidermis and dressed with a vaseline gauze pressure dressing. Antibiotics are routinely administered as a prophylactic measure. Early ambulation has also been employed routinely.

CASE REPORTS

The following reports illustrate the types of cases in which cutis graft lends itself, in the repair of hernial defects and other mentioned conditions.

Case 1 (see figure 4). A 56 year old white man was admitted to the SR Hospital, January 1948, with a tentative diagnosis of intestinal obstruction. Examination revealed a large nonreducible incisional hernia of the lower right abdomen with numerous loops of adherent intestine in the sac. The first operative procedure had been a laparotomy, using a lateral

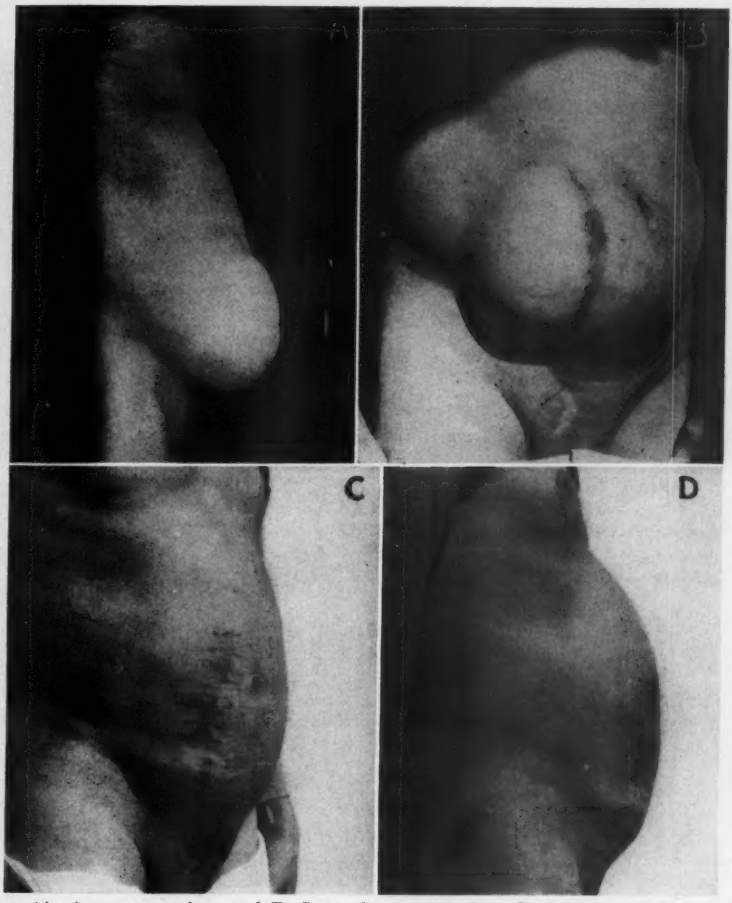

FIG. 4A. Anteroposterior; and B. Lateral, preoperative. C. Anteroposterior; and D. Lateral, postoperative.

pararectus (Battle) incision, with appendectomy and drainage through the wound for a ruptured acute appendicitis with appendiceal abscess. The resulting hernia had been operated upon unsuccessfully elsewhere on 2 previous occasions. On this occasion the intestinal obstruction was treated by nonoperative means. His general condition improved, and the hernia was subsequently repaired, using cutis graft reinforcement. Convalescence was uneventful and there has been no recurrence of the hernia or symptoms referable to its repair.

Case 2 (see figure 5). A 50 year old white woman was admitted to the SR Hospital, September 1947, for repair of incisional hernia. The first operation had been a subtotal hysterectomy through a midline incision, some 12 years prior to admission. Five unsuccessful attempts had been made to repair the hernia before she was first seen by the authors. Examination revealed the patient to be rather markedly obese. There was a large easily reducible ventral hernia occupying the entire lower abdomen and the abdominal viscera was definitely adherent to the sac. She was placed on a reduction regime in preparation for operation. The hernia was repaired, using cutis graft reinforcement. Her postoperative

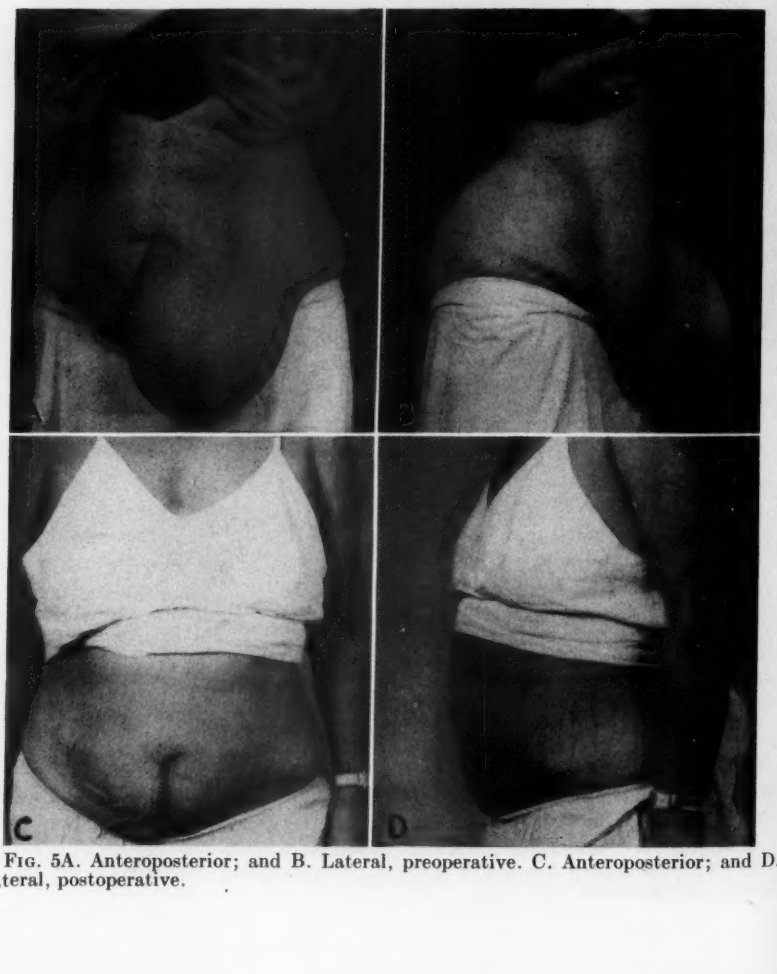

FIG. 5A. Anteroposterior; and B. Lateral, preoperative. C. Anteroposterior; and D. Lateral, postoperative.

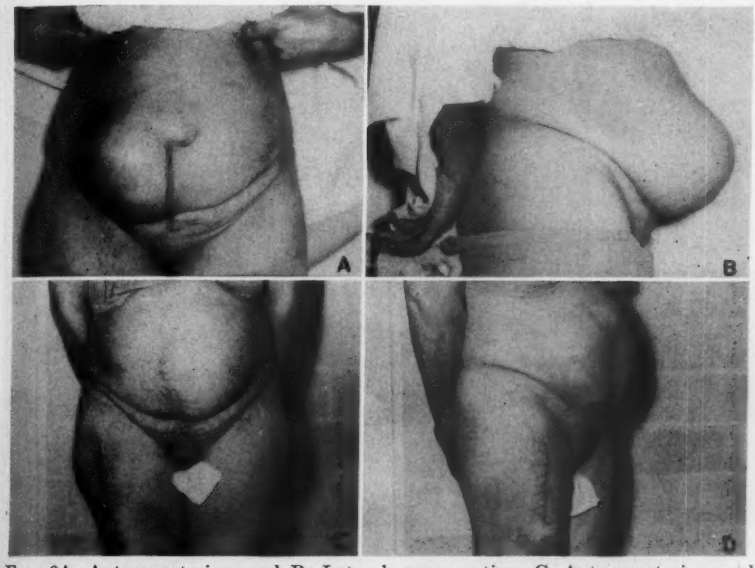

FIG. 6A. Anteroposterior; and B. Lateral, preoperative. C. Anteroposterior; and D. Lateral, postoperative.

course was uneventful. The hernia repair has remained intact. A complete prolapse of the cervix, with accompanying marked cystocele, developed later following repair of the hernia. This required subsequent repair by vaginal route, which likewise has remained intact.

Case 3 (see figure 6). A 54 year old Latin American woman was operated upon on June 4, 1954, at the D. M. Hospital for repair of large incisional hernia, using cutis graft reinforcement. The hernia followed a pelvic laparotomy through a midline incision done elsewhere 4 years prior to admission for fibromyomatas of the uterus, a supravaginal subtotal hysterectomy having been done. Examination revealed a large hernia in the lower midportion of the abdomen as shown. Her general condition was otherwise good. The operation was performed using cutis graft from skin of the right thigh; the donor site being closed primarily. Her course, postoperatively, was uneventful and the result has been entirely satisfactory to date. This case demonstrates removal of cutis graft from the leg with primary closure, rather than grafting of the donor site. Photographs taken prior to operation and 1 month postoperative.

Case 4 (see figure 7). A 44 year old Latin American woman was admitted to the MH Hospital on July 2, 1954 complaining of a large ventral hernia and uterine bleeding. Appropriate studies had excluded malignancy of the uterus. The patient was found to have a large ventral hernia, and menopausal uterine bleeding associated with chronic cervicitis, marked rectocele, and perineal relaxation. The ventral hernia had resulted from an appendectomy done elsewhere through a lateral pararectus (Battle) incision. One unsuccessful attempt had been made to repair this hernia elsewhere. The authors performed repair of rectocele, perineum, and a total hysterectomy, along with repair of the ventral hernia, using cutis graft reinforcement. The cutis graft was taken from the right anterior thigh. The donor site was grafted with the epidermis removed in securing the underlying cutis. Her postoperative course was uneventful, and when last examined there was no recurrence. This case illustrates the use of cutis with coverage of the donor site by the previously removed split graft of epidermis. Photographs were taken immediately prior to operation and 1 month postoperatively.

FIG. 7A. Anteroposterior, preoperative. B. Anteroposterior; and C. Lateral; postoperative.

Case 5 (see figure 8). A 62 year old Negro man was admitted to the RBG Hospital July 1954, because of a painful pulsating mass in the right neck, which was found to be an aneurysm of the innominate artery. On observation in the hospital, it was believed that the aneurysm was rapidly increasing in size and that surgical intervention would be necessary to prevent subsequent rupture of the aneurysm. At operation the aneurysm was found to involve the innominate, right subclavian, and right common carotid arteries, as shown. Satisfactory reinforcement was obtained by means of cutis graft sutured around the aneurysmal dilatation of the vessels with interrupted cotton sutures as shown in figure 8. His postoperative course was satisfactory for 3 weeks, when sudden death occurred. Autopsy revealed the cause of death to be an unsuspected brain tumor, into which acute hemorrhage had occurred. The aneurysm was intact and the cutis graft in satisfactory condition. The technics of external support to aneurysmal dilatations, by reactive cellophane or cutis, are now admittedly second in choice to resection and replacement in most situations; however, where resection would involve clamping the common carotid artery, the danger of resection and replacement, with or without hypothermia, is increased.

Case 6 (see figure 9). A 29 year old Negro man was admitted to the BM Hospital on April 16, 1952, for repair of acromioclavicular and coraco-acromial separation of the right shoulder, following injury sustained on Aug. 7, 1952, when he was struck by an automobile. These injuries were repaired by Bunnell's method, with pullout wires, but using cutis graft in place of facial strips. Postoperative recovery was marred only by difficulty in removing one wire suture which became broken sometime between insertion and removal. He regained normal use of his shoulder and has been returned to work. His roentgenograms are shown in figure 9.

Case 7. A 53 year old white woman was admitted to Nix Memorial Hospital on Sept. 26, 1953, for repair of large recurrent cystocele. A subtotal hysterectomy and vaginal plastic, including cystocele repair, had been done in 1943. A second vaginal plastic operation was

FIG. 8A. Anteroposterior, preoperative. B. and C., postoperative

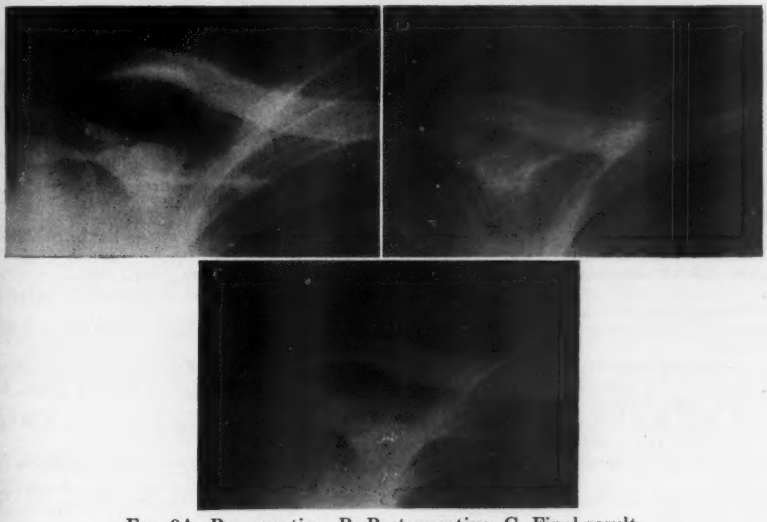

FIG. 9A. Preoperative. B. Postoperative. C. Final result

done in 1946 at which time the patient stated that her cystocele was again repaired by the same surgeon. In 1948 a second surgeon performed a vaginal plastic procedure to correct a vaginal atresia. Repair of the recurrent cystocele was accomplished by reinforcing the vesicovaginal space with a patch graft of cutis from the anterior right thigh. Her postoperative course was uneventful. The cystocele was well repaired and the patient asymptomatic when last examined on Sept. 3, 1954. The operation was performed by Moore[40] and the senior author.

(*Note:* Two similar cases, 1, a recurrent cystocele, and, 2, an enterocele have been repaired by cutis graft method since this time by the senior author with satisfactory results.)

SUMMARY

1. Brief remarks have been made as to the use of various materials in reconstructive surgery, together with a listing of some that have been used.
2. Definition of cutis graft and historic review has been given.
3. The healing and fate of cutis graft has been discussed.
4. The various clinical uses of cutis graft, both by the authors and others, have been presented.
5. The indications and contraindications of the use of cutis graft have been offered, together with a description of the technic of its use.
6. Illustrative case reports have been presented.

CONCLUSIONS

Cutis graft is an easily procured, always available, material which has proved satisfactory in various reconstructive procedures in the body. It has been used successfully for a number of conditions by many surgeons in various fields. It is believed that its usefulness and merits deserve re-emphasis.

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PSEUDOCYST OF THE BREAST ASSOCIATED WITH RHEUMATOID ARTHRITIS

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Case histories are the building blocks of clinical medicine. The rare cases of today may be the common knowledge of tomorrow, provided they are recorded in the literature instead of gathering dust in the basements and storerooms of our hospitals, or being destroyed because of lack of space. Therefore a rare case of pseudocyst of the breast is worth reporting. A similar case has not previously been recorded in the literature.

A 69 year old white woman was admitted to Prospect Heights Hospital on July 1, 1946 with a diagnosis of cystic tumor of the right breast. The patient stated that in the past year she had noticed that her right breast became progressively larger and "spread upward" on her chest. She called a doctor to the house who told her that she had a cyst of the right breast.

Her past history revealed that she had had poliomyelitis as a child, rheumatoid arthritis and heart disease for many years, malaria in 1901, right salpingo-oophorectomy in 1906 and thryoidectomy in 1941. Her family history was essentially negative.

Examination revealed an elderly, pale, undernourished white woman walking about with difficulty, wearing metal braces. The right breast was indurated and uniformly enlarged by a cystic mass whose borders could not be defined. The greatest part of the cystic mass involved the right pectoral region, extending to the anterior border of the axilla and about two fingerbreadths below the right clavicle (fig. 1). The nipple was soft, of normal texture, freely movable and not retracted. The opposite breast was soft and flabby without any tumefaction. Both axillas and supraclavicular regions were free from any palpable lymph nodes. The superficial veins over the manubrium were dilated.

The heart was larger than normal with a systolic murmur at the apex. The pulse was 100 and regular. The blood pressure was 170/110. The lungs were clear. The abdomen and pelvis were negative for pathology. The joints of the upper and lower extremities were badly deformed and ankylosed with atrophy of the soft tissue above and below the joints. Both patellas were displaced laterally and badly deformed.

The blood count showed a low grade secondary anemia. The urine was negative. Routine blood chemistry was within normal limits, the blood Wassermann negative. Roentgen examination of the chest and right shoulder revealed osteoarthritic changes in the achromioclavicular joint, with periosteal thickening and punched-out areas of decreased density of the outer part of the right clavicle. There was a generalized soft tissue swelling over the right pectoral region and some bulging of the right shoulder joint. The heart was slightly enlarged, the aortic arch calcified. The mediastinum was clear and the diaphragms intact.

FIG. 1. Cystlike mass involving right breast and pectoral region

On July 2, 1946 the patient was taken to the operating room, and under general anesthesia a radial incision was made above the areola. A gush of sanguinous cloudy fluid came out under pressure, leaving an empty pouch. Digital examination revealed a cavity as far as the finger could reach. The incision was lengthened for a more thorough exploration. As the examining finger extended toward the shoulder joint, firm projections from the rim of the glenoid fossa could be palpated. Some of them were broken off by the palpating fingers. The fluid and the broken-off specimens were sent to the laboratory for histologic examination. The wound was closed and a drain inserted. The patient left the operating room in good condition.

The laboratory report by Dr. Silik H. Polayes, pathologist, was as follows: "Gross specimen consists of four pieces of tissue, the largest 1.5 cm. in greatest diameter. One of the pieces contains a fragment of cancellous bone 1 cm. in length. Accompanying the specimen is a moderate amount of bloody fluid containing many blood clots, and also a small amount of blood-tinged fluid, having a slightly cloudy appearance.

"Microscopic: The tissue is hyaline cartilage and fibrous tissue showing many small areas of calcification. Some areas of the surfaces are covered by mesothe-

lial cells (bursa). The osseous tissue is essentially normal, but in the surrounding fibrous tissue there are many small collections of brown pigment. The centrifuge specimen reveals the fragment of brown substance to be composed almost entirely of blood clot. However, there are occasional small areas composed of mesothelial cells. Culture of the fluid revealed it to be sterile. Microscopic examination shows markedly degenerated cells, which cannot be further identified.

"Diagnosis: 1. Calcified fibrocartilage and bursal lining. 2. Blood clots. 3. Sterile fluid."

The wound healed by primary union and the patient was discharged from the hospital on July 10, 1946 in good condition. She was last seen on May 26, 1956. Examination revealed no evidence of recurrence. The only complaint the patient had was being "tired."

Impression: The patient had an accumulation of synovial fluid in her right shoulder joint as a result of chronic rheumatoid arthritis. The fluid broke through the joint capsule and gravitated to the right pectoral region and breast, simulating a large mammary cyst. It is surprising that the fluid has not recurred during the 10 years since its removal.

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BRACHIAL ARTERY EMBOLISM: REPORT OF THREE CASES AND REVIEW OF THE LITERATURE

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INTRODUCTION

Embolism of the brachial artery constitutes 10 per cent of all peripheral arterial emboli. However, the literature is almost void of articles dealing specifically with this subject. From this fact it follows, that most cases of brachial artery embolism remain unreported and probably some are unrecognized. The total number of reported cases is less than 200 (Nystroem[31] and Key:[26] 40; Pearse:[33] 40; Danzis:[10] 19; McClure and Harkins:[29] 40; Haimovici:[22] 30; Des Prez:[14] 11; Veal and Dugan:[37] 9; Duncan:[17] 10; Andrus:[4] 10; Allen:[2] 9; solitary case reports 1943–54: 20). All solitary case reports up to 1943 are included in the collective series of Nystroem,[31] Key,[26] Pearse,[33] Danzis,[10] McClure and Harkins.[29] From 1943–1954 only 20 case reports have been published.[1, 8, 11, 12, 16, 18, 21, 32, 34, 39] We have attempted in this paper to collect all pertinent date concerning embolic phenomena of the brachial artery.

CASE REPORTS

Case No. 1. E. R. A 36 year old white woman entered St. Luke's Hospital on Feb. 2, 1953 with a history of acute pain in the right upper and lower arm, present for 2 weeks. The pain had persisted and was localized from the junction of the upper and middle third of the right arm down to the finger tips. She also had developed increasing weakness of the forearm. Her past history revealed rheumatic fever at the age of 7. She was asymptomatic until 1947, when she developed acute cardiac failure with pulmonary edema during delivery of her third child. She remained in an oxygen tent for 56 days. She was digitalized and had been maintained continuously on gr. 1½ daily. In May 1952 she had another episode of acute heart failure with numbness in the right arm and hand and temporary loss of function. The radial pulse remained present during this episode. Family history revealed that one sister died of heart disease at the age of 17 years.

Examination on admission blood pressure was 120/80, pulse 80 and regular. Electrocardiogram showed signs of digitalis effect. Chest roentgenogram revealed the heart to be enlarged and of mitral contour. The white blood cell count was 6,300 per cu. mm. Sedimentation rate was 31 mm. in 60 minutes (Wintrobe). Urinalysis was negative. The right arm had a blanched aspect, the veins were collapsed and no radial pulse was palpable. Axillary pulsations were present. The skin temperature was 26½ C. as compared to 29½ C. on the opposite side. Oscillometric readings proved the site of occlusion to be in the proximal brachial artery. The heart was enlarged to the left and a systolic and diastolic murmur was audible at the apex. A diagnosis of recurrent brachial artery embolism on the basis of rheumatic heart disease was made. Treatment consisted of right Stellate ganglion block with procaine; priscoline 50 mg. four times daily; heparin and dicumerol. The prothrombin time (Quick) was maintained with 50 mg. of dicumerol daily at 24 seconds for the next 12 weeks. The patient was discharged in satisfactory condition on the tenth day, the radial pulse again being present. She was referred to the University Hospital in Philadelphia for evaluation and on

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May 25, 1953 a mitral commissurotomy was performed by Dr. J. Johnson. Since then she has been asymptomatic.

Case No. 2. M. Q. A 73 year old white woman was admitted to the hospital on May 22, 1956 complaining of acute pain and numbness in the left arm of 2 hours duration. She had become increasingly dyspneic during the preceding 2 days and had been digitalized for cardiac failure. Her past history revealed severe arterial hypertension. Examination on admission blood pressure was 250/100, pulse 84 and regular. The electrocardiogram showed extrasystoles. Chest roentgenogram revealed congestion of both lung fields and marked cardiac enlargement with a cardiothoracic ratio of 61 per cent. Venous pressure was +10 (Lewis-Borst). The white blood cell count was 12,000 per cu. mm. There was a harsh systolic murmur audible over all areas. The left axillary artery was pulsating down to the deltoid groove. The forearm was cold and the radial pulse absent. No blood pressure was obtainable in the left arm. Sensation and motor power were diminished. Oscillometric readings showed occlusion of the proximal brachial artery. The diagnosis of brachial artery embolism was made and the patient was immediately started on Depo-Heparin; dicumerol; ice caps; papaverine; roniacol; intravenous procaine and sedation. A cervical sympathetic block was performed with marked improvement in skin color and temperature. There was no Horner's syndrome. The prothrombin time was kept at 19–24 seconds (Quick) for the next 10 days. The blood pressure reduced to 180/90 and function of the arm returned to normal. The radial pulse has not returned and there have been no recurrences.

Case No. 3. A. S. A 58 year old white man entered the hospital on May 20, 1956 because of arteriosclerotic heart disease with cardiac decompensation. His past history revealed an anterior coronary occlusion with a mural thrombus in July 1946, followed by a cerebral embolus in the same month. In March 1950 he had a second coronary occlusion, this time a posterior infarct followed by atrio-ventricular block. He recovered and resumed part-time work. Examination on admission blood pressure was 130/80; venous pressure +8 (Lewis-Borst); electrocardiogram revealed auricular fibrillation, old posterior damage and partial block. Chest roentgenogram showed the heart to be enlarged with a cardiothoracic ratio of 55 per cent and pulmonary congestion. The patient was digitalized with digitoxin .2 mg. daily and when he developed extrasystoles he was placed on quinidine 3 gr. twice daily. On May 23, 1956 he developed acute severe pain in his right arm with partial loss of motor power. The radial pulse could not be palpated. Axillary pulsations were present. Oscillometric readings confirmed the diagnosis of right brachial embolism. He was sedated and ice caps were applied. On this regimen the color of the arm improved rapidly and function returned. The radial pulse remained absent. He was discharged on June 4, 1956 in satisfactory condition.

ETIOLOGIC ASPECTS

There is a general agreement today, that the left heart is the site of primary thrombosis and the source of peripheral emboli in almost all instances. Paradoxical emboli through an open foramen ovale, thrombi arising from aortic aneurysms or atheromatous plaques secondary to arteriosclerosis have occasionally been encountered, but appear to be extremely rare. The incidence of proved intracardiac pathology varies from 89[39] per cent to 95[14] per cent and 96[23] per cent of cases in the respective series. Arteriosclerotic heart disease, including myocardial infarction leads the group of cardiac pathology responsible and was found present in 51[22] per cent to 61[14] per cent, followed by rheumatic heart disease in 33[14] per cent to 40[23] per cent of cases with bacterial endocarditis taking third place with 5 per cent only. The importance of auricular fibrillation as causative factor has long been established and 80[14, 23] per cent of patients with peripheral arterial emboli have some type of cardiac arrhythmia. Two of our 3 patients were found

to be fibrillating. In the third patient fibrillation had been converted into regular sinus rhythm with digitalis only shortly before the embolism occurred. It is particularly this point of conversion from feeble irregular beats to forceful regular contractions which often causes mural thrombi to detach and enter the arterial blood stream. From the aforementioned series of compiled cases it appears, that the upper extremities are the site of embolism in about 16 per cent; 4 per cent lodging in the axillary artery, 10 per cent[14, 23, 31, 33] in the brachial and 1 per cent each in the radial and ulnar arteries respectively. There seems to be no predilection for the right side as reported by some authors. Obviously all age groups are represented, although the peak is in the sixth decade. Des Prez[14] reported the average age in the rheumatic heart disease group as 40 years against 66 years in the arteriosclerotic heart disease group. Females are affected more often than males. Of Haimovici's[23] 30 cases of brachial artery embolism 21 of the patients were females, as were 2 of our 3 patients.

PATHOPHYSIOLOGIC AND ANATOMIC CONSIDERATIONS

Pathophysiology: The foundation of present day understanding of the pathophysiology of peripheral embolism was laid by a group of French vascular surgeons. As early as 1924 Leriche stated that the resulting ischemia was not due to primary occlusion or the progression of thrombosis in the collateral vessels, but to the blocking of arterial circulation by truncular irritation. Haimovici's experimental work proved, that the main factor in the pathologic physiology of peripheral arterial embolism is a vasoconstrictor reflex, which originates from the adventitia of the occluded vessel at the point of obstruction. Both Haimovici and Leriche consequently recommended sympathectomy and arteriectomy to eliminate this reflex. Various factors are involved in the mechanism of occlusion. The embolus in lodging at a certain segment will give rise to a partial mechanical obstruction of the blood flow. The resulting stagnation causes an immediate distention of the proximal arterial segment. Stimulation of its adventitial sensory nerve fibers triggers the sympathetic vasoconstrictor reflex, which causes vasospasm of the main and collateral arteries and arteriolae, distal to the point of obstruction. If this acute constrictive phase persists ischemia and eventually gangrene are inevitable. The degree of arterial spasm and the means available to relieve it, the extent of secondary thrombosis and the location of the embolus are therefore of primary importance for the prognosis. Delay in treatment of more than a few hours will cause structural changes of the intima with complete occlusion of the vessel by progressive secondary thrombosis.

Anatomic considerations: The absence of gangrene of the forearm or hand following brachial artery embolism is readily explained by its well developed network of collaterals and anastomoses in contradistinction to common iliac occlusion. Three main pathways provide for an usually adequate collateral circulation. They are: 1. Profunda brachii artery. 2. Superior ulnar collateral artery. 3. Inferior ulnar collateral artery (fig. 1).

1. The profunda brachii artery arises from the main brachial artery only a

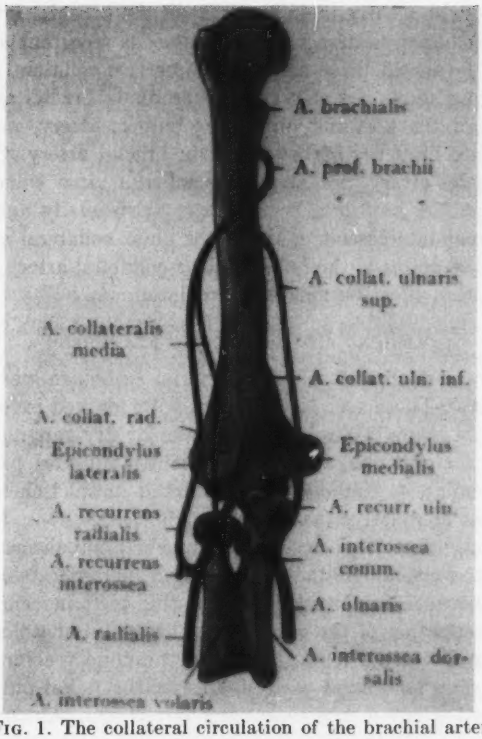

FIG. 1. The collateral circulation of the brachial artery

short distance from its origin. It divides into an anterior (art. collat. radialis) and posterior (art. collat. medialis) descending branch. The anterior descending branch anastomoses with the recurrent radial artery, a branch of the radial artery; the posterior descending branch anastomoses with the recurrent interosseous, a branch of the ulnar artery, and the inferior collateral ulnar arteries. The posterior descending branch also gives off the ramus deltoideus, which anastomoses with the posterior circumflex humeri artery, a branch of the axillary artery.

2. The superior ulnar collateral artery originates from the midportion of the brachial artery. It anastomoses directly with the posterior recurrent ulnar and inferior ulnar collateral arteries.

3. The inferior ulnar collateral artery (supratrochlear artery) arises about 2 inches above the brachial bifurcation in the trochlear region. It forms a wide anastomotic network at the elbow (rete articulare cubiti) by connecting with the anterior and posterior recurrent ulnar arteries, superior collateral ulnar artery, the posterior descending branch of the profunda brachii artery and the interosseous recurrent artery.

Since communications exist between the axillary and radial and ulnar ar-

teries by means of these three main branches of the brachial artery proximally and the radial and ulnar recurrent and interosseous recurrent arteries distally, occlusion at any level will leave at least one or two collateral channels open. An embolus lodging above the origin of the profunda brachii artery will effect blood flow through the posterior circumflex humeri artery, ramus deltoideus and the descending branches of the profunda brachii artery. Occlusion below the profunda brachii artery, but above the superior ulnar collateral artery effects a bypass via the profunda brachii artery proximally and the recurrent radial and recurrent interosseous and inferior ulnar collateral arteries distally. Occlusion below the origin of the inferior ulnar collateral artery leaves all three pathways open for an effective collateral circulation.

CLINICAL AND DIAGNOSTIC FEATURES

A classification of 4 clinical forms of arterial embolism was introduced by Haimovici[23] in 1950. These are: 1. Embolism with marked ischemia and death occurring within 24 hours. 2. Embolism followed by dry gangrene. 3. Embolism with marked initial ischemia, which subsequently subsides partially (chronic postembolic ischemia). 4. Embolism with marked initial ischemia, which subsequently subsides completely (anischemic embolism).

Statistics reveal,[23] that 70 per cent of all brachial embolisms fall in group 4. It has been pointed out above, that the widely dispersed network of collaterals and anastomoses are mainly responsible for this high percentage of survival and functional restitution of the extremity. The symptomatology is typical. A sudden onset of pain (60 per cent) followed by numbness, coldness and tingling of the extremity and associated with absence of the radial pulse (asphygmia), partial loss of motor power and sensation, paresthesia, skin discoloration and diminished reflexes and altered sudomotor reactions. The vital signs are unaltered and fever is rarely present in spite of moderate leukocytosis. The pain is usually severe and caused by vasospasm. But although present as an initial symptom in 80 per cent and in the late stages in over 90 per cent of patients, its onset is delayed or it is even absent (silent emboli) in 1 out of every 5 patients. It thus appears that absence of pain does not preclude the presence of acute brachial embolism. The hypothermia and blanched aspect of the arm, the loss of voluntary motion and absence of radial pulse are the next important signs. Angiography and retrograde arteriograms have been advocated by Leriche[27] and Fontaine[20] for the purpose of localizing the embolus and to differentiate embolic occlusion from vasospasm, but they are definitely contraindicated in brachial artery embolism.[13] Oscillometric readings are easily obtained and valuable in determining the site of the occlusion.[22]

There are 3 zones. A proximal one with normal pulse amplitude, a diminished one corresponding with the site of embolism and a distal zone with no oscillations whatsoever. The proximal zone of the affected limb usually shows a higher amplitude as compared to the opposite side. The loss of sensation often does not extend as high as the area of hypothermia. The conditions to be considered in the differential diagnosis are: 1. Essential arterial spasm, secondary to hy-

pertension. 2. Acute arterial thrombosis (trauma, Buerger's disease, acute infections). 3. The first stage of acute thrombophlebitis (pseudoembolic syndrome). 4. Anterior scalenus syndrome. Paravertebral blocks and spasmolytics may be valuable aids in distinguishing between these disorders and embolism.

TREATMENT

A wide variety of therapeutic measures has been employed in the treatment of brachial artery embolism with varying results. These include antispasmodic drugs, anticoagulants, regional nerve blocks, refrigeration, periarterial and cervical sympathectomy, alternating pressure methods, arteriectomy and embolectomy. Fortunately, during the last decade general agreement has been reached as to the indications and combinations of some of these measures. The chief aim is the prevention of gangrene by relief of the initial vasospasm and restoration of blood flow through collaterals by conservative means. No exact mortality figures are available, but the mortality of brachial embolism following these conservative measures is estimated to be less than 6 per cent.

SURGICAL PROCEDURES

1. *Embolectomy:* Prior to 1935 embolectomy was considered the most effective means of therapy and this method was extensively used by a group of Swedish surgeons (Key, Stroembeck, Nystroem). Their results were not too encouraging. Pearse[33] reported in his collective review only 47 per cent of embolisms in the upper extremities, treated by embolectomy during the first 10 hours, to be successful. Of Danzis[10] compiled 19 cases of brachial embolectomy, 15 recovered with full restoration of the circulation. With the introduction of anticoagulant therapy and through better understanding of the physiopathologic processes involved, which led to the abolition of heat treatment and elevation, the trend towards conservative measures became more pronounced and today most authors agree that embolectomy is contraindicated in the treatment of brachial embolism. This trend can be seen clearly in recent statistics. Of Haimovici's[23] 30 cases of brachial embolism only 4 of the patients were treated by embolectomy, 2 of these without restoration of the circulation. 2 of Des Prez'[14] 8 patients were treated by embolectomy, one requiring subsequent amputation, and of Veal's[37] 9 patients again only 2 (both septic emboli) were treated surgically. In none of the 10 patients who had brachial embolism encountered by Andrus[4] was embolectomy performed. Resection of the auricular appendages as a preventive measure in arteriosclerotic heart disease and midarm amputation following onset of gangrene are self-explanatory and need not be discussed here. Amputation should, if possible, be delayed until the collateral circulation has been developed fully.

2. *Arteriectomy:* This procedure was first recommended by Leriche[27] in 1924, as a means of preventing secondary thrombosis. He argued, that by excising the occluded arterial segment not only the collateral circulation is actively stimulated (vasodilatation) but the source of the vasoconstrictor reflex is eliminated at the same time. However, with the exception of cases of septic emboli,

which may give rise to mycotic aneurysms, this procedure has rarely been employed and there are only 2 reports in the American literature, (Schein,[35] de Takats[15]). If performed special attention should be given to the preservation of the proximal and distal collateral branches.

3. *Sympathectomy:* Cervical or periarterial sympathectomy have been very rarely employed and the opinions of various authors are divided. Leriche,[27] Haimovici[23] and Andrus[4] recommend these procedures, whereas Olwin[32] and Lund[28] saw no improvement in the circulation following postembolic sympathectomy. Haimovici pointed out, that in patients in whom embolectomy is being done, a periarterial sympathectomy is also being carried out simultaneously by exposing the artery, thus interrupting the pathways of the spastic reflexes. Bedrna[6] employed with good results cervical sympathectomy in patients, who did not respond to conservative measures. We believe however, that this procedure should be carried out only in the late postembolic ischemic phase.

CONSERVATIVE PROCEDURES

1. *Spasmolytic agents:* Papaverine (Spasmalgine), atropine, acethylcholine and procaine are the drugs used. The route of administration should be intra-arterial and proximal to the site of occlusion, to be fully effective. Newer drugs such as priscoline and etamon (tetraethylammonium chloride) have been employed occasionally. Their effectiveness in embolism has not been evaluated.

2. *Regional plexus and ganglion blocks:* Paravertebral block of the stellate ganglion or brachial plexus anesthesia with procaine have been recommended by Brandsma[8] and Ansbro.[5] They have been widely used with good results. Holden[25] pointed out however, that the spasm of the larger arteries is intrinsic, i.e. myogenic in origin and not subject to sympathetic control. Interruption of the sympathetic pathway abolishes the vasospasm of the collateral arteries and arteriolae leaving the occluded vessel itself unaffected. None the less, this procedure is generally considered to be the most effective type of treatment and should be used at the onset of symptoms in all patients.

3. *Anticoagulants:* An important contribution was made in 1935 with the introduction of the anticoagulants Heparin and Dicumerol and their derivatives. These drugs, by interfering directly with the normal blood coagulation mechanisms, are most valuable aids in the prevention of secondary thrombosis in the affected vessel and also by eliminating recurrences of intracardiac thrombi. The results of their combined use have been so gratifying, that Allen[2] (Mayo Clinic) recommends their exclusive use combined with spasmolytics and condemns any kind of surgical procedure.

4. *Supportive miscellaneous procedures:* These consist of alternating pressure methods; refrigeration and the prevention of measures harmful to the affected extremity, i.e. the application of heat locally and elevation. In view of present day knowledge employment of the latter combination must be considered a grave error, leading to gangrene and loss of the limb. Elevation increases the degree of existing ischemia distal to the point of occlusion by further diminish-

ing the arterial blood flow. A drop in systolic pressure below 15 mm. Hg, the critical level below which gangrene developes, has frequently been observed.[23, 30] The increased venous pressure present in those patients with cardiac decompensation, interferes further with adequate oxygenation. The absurdity of heat application, which increases local tissue metabolism is obvious, when considering the fact that it results in an increased oxygen demand of the tissues at a time of diminished blood flow. The question of refrigeration is more controversial. Introduced by Allen[3] and widely used today, it has met opposition from Haimovici, whose work tends to indicate that it is harmful rather than beneficial. He pointed out that cooling of the extremity results not only in a reduction of tissue metabolism, which is desirable, but also produces vasospasm to a considerable degree, thus further diminishing the arterial blood supply and directly interfering with the development of the collateral circulation. The alternating positive and negative pressure method (Pavaex) introduced by Herrmann and Reid[24] and intermittent venous occlusion, which was used on a large scale by Collens & Wilensky[9] are of doubtful value and the published reports are conflicting.[9, 15, 24, 39]

COMMENT

From the foregoing data it appears, that early diagnosis and the prompt institution of conservative measures are of paramount importance for the prognosis and the prevention of embolic gangrene. Relief of vasospasm and development of an adequate collateral circulation are the principles on which treatment is based. The therapy recommended consists of the immediate combined use of anticoagulants and spasmolytics, i.e. the intraarterial administration of papaverine plus stellate ganglion block or brachial plexus anesthesia. The affected extremity should be kept in a dependent position and ice caps applied. Embolectomy should never be employed and arteriectomy should be performed only in cases of septic emboli. Sympathectomy is the procedure of choice for chronic postembolic ischemia, if ganglion blocks show good temporary results. The final outcome in regard to survival of the arm does not depend upon the site of embolism along the brachial artery trunk. However, the prognosis in regard to life depends upon the cardiac status of the patient and recurrent future embolic episodes, since many patients suffer from multiple consecutive emboli. Seventy per cent of all conservatively treated patients who had brachial embolism recover completely, from the functional standpoint, even though the radial pulse often remains absent.

SUMMARY

Three cases of brachial artery embolism in which the patients were treated conservatively are reported.

The literature is reviewed and 200 previously reported cases are analyzed.

The etiology, pathophysiology, anatomy, classification, symptomatology, diagnosis and treatment are discussed.

The importance of early diagnosis and the immediate institution of conservative treatment is stressed.

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SURGICAL APPLICATION OF AN ACRYLIC RESIN PLASTIC AS WOUND DRESSING, SKIN PROTECTANT, AND OPERATIVE FIELD PREPARATION

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Advances in the field of hydrocarbon chemistry have resulted in the development of a number of solid and fluid plastics which have applications in the field of clinical medicine. The present investigations were undertaken to assess the uses of a fluid acrylic resin plastic in clinical surgery.

Surgeons and practitioners have for many years employed Collodion U.S.P. for the dressing of wounds where the application of a standard gauze and tape dressing is impractical. This simple dressing has proved useful in covering sutured lacerations of the scalp where surrounding hair makes the application of tape difficult. It has been of value in dressing abdominal incisions in pediatric patients where it is desired to exclude urine and feces from fresh incisions[6]. DeBakey, Giles, and Honold[5] have described the use of a vinylite resin (with acetone and nitrocellulose) as an impermeable adhesive skin coating for the protection of operative fields. Presman[10], Choy and Wendt[2-4], Rigler and Adams[11], have used similar plastics as a wound dressing. Wright[13], Olow and Hogeman[9], and Rob and Eastcott[12] have employed a fluid plastic of the acrylic type for wound dressings and the preoperative preparation of a sterile field.

The utility, economy, and convenience of these plastics is already well documented. Our own clinical experience over a period of 3 years indicates that the physical properties of certain of these plastics limit their usefulness in those situations where theoretically they would be of greatest advantage. Thus, it was found that one of the vinyl resins became rather stiff on drying and failed to bend with the changing contour of the patient's skin. This resulted in premature separation of the dressing from the wound. Similarly, when an attempt was made to use the plastic as a skin protectant around intestinal fistulas, lack of adhesion between the skin and plastic caused separation of the dressing in the area immediately adjacent to the fistula. Our most recent experience has been with an acrylic resin, with physical characteristics that make it the most satisfactory dressing we have tested.

PHYSICAL CHARACTERISTICS

The plastic is a clear, viscous fluid consisting of an acrylic resin dissolved in ethyl acetate with castor oil added as a plasticizer.* For convenience, the plastic

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* The material was generously supplied for investigative purposes by the Bofors Nobelkrut Company, Bofors, Sweden. It is marketed in Sweden under the trade name of "Nobecutane." It is not commercially available in the United States. Certain of the data on physical characteristics were supplied by the manufacturer.

is dispensed from an aerosol bomb which employs freon, a volatile halogen hydrocarbon, as a propellant. When the dispenser is held at a distance of 15 cm. from the skin surface, the freon is dissipated immediately, and the ethyl acetate solvent evaporates in about 60 seconds, leaving a tough film of acrylic plastic on the skin surface. In ordinary use, a semipermeable plastic membrane approximately 30 mu in thickness is formed on the skin surface. Bacteriologic studies indicate that the plastic so stored is sterile and forms a film that is impermeable to the passage of bacteria. A film of the usual thickness permits the passage of approximately 17.5 mg. of water vapor per $cm.^2$ per day.

As pointed out by Grossmann[7], a major problem related to the use of plastic resins as a wound dressing is their inflexibility which tends to cause separation of the dressing from the skin. The unique success of the acrylic resin described here is largely attributable to its elasticity and flexibility. A 0.1 mm. film of the plastic can be stretched to 9 times its original length without breaking. A similar film can be double-folded 1,400 times before breaking.

WOUND DRESSING

The plastic was used as the only dressing in approximately 500 surgical wounds. At the end of the operative procedure, the incision was sprayed with plastic, and 1 minute was allowed for drying before the patient was transferred from the operating table to his bed. (The plastic dressing was not employed in draining wounds where an absorbent dressing was required.) Sutures were removed, after the usual interval, by first dissolving the plastic film with acetone applied on a gauze sponge.

Satisfactory healing occurred and no instance of allergic sensitivity to the plastic was noted. A number of minor wound infections which occurred were considered unrelated to the use of the plastic dressing. These results substantiate our earlier observations in which wound healing was found to be little affected by the type of dressing employed. In these previous experiments, alternate patients had either the standard gauze and tape dressing applied to their operative wounds or no dressing at all. There was no clinically detectable deficit in the healing of wounds treated without a dressing. These results confirm the observations of Heifetz and associates[8] who noted no difference in wound healing and no increase in skin bacteria count in those patients whose wounds were left open to air. Perhaps the choice between plastic, gauze, or no dressing for the average clean surgical incision is a matter of esthetics or personal preference. However, there were several distinct areas where the plastic dressing was found to be uniquely superior.

Adjacent contamination: The acrylic plastic is the preferred dressing when clean incisions are located close to sources of potential contamination. Thus, an abdominal incision can be completely protected from an adjacent colostomy. In pediatric surgery the plastic dressing is useful for keeping urine and feces from fresh abdominal incisions.

Thoracic surgery: The standard gauze and tape dressing obliterates approximately 75 per cent of the surface area available for auscultation of the operated

hemithorax. It is, therefore, our practice to employ the plastic dressing in all clean thoracotomy cases so that the diagnosis of atelectasis and pleural fluid can be readily made on physical examination during the postoperative period.

Radical mastectomy: A very satisfactory dressing for radical mastectomy can be made by combining negative pressure drainage of the skin flaps with the plastic dressing. The disadvantages of the standard sponge, cotton waste, and elastic adhesive dressing for radical mastectomy are several. The dressing becomes loose within several days of its application and requires replacement at a time when the skin flaps are not yet firmly fixed to the chest wall. The absorbed secretions make the dressing stiff, uncomfortable, and malodorous, particularly in hot weather. The pressure applied by such dressing is frequently not uniform. The progress of healing and the condition of the skin flaps are unknown to the surgeon until the time of the first dressing.

Figure 1 illustrates a mastectomy dressing which eliminates each of these disadvantages. Two or three no. 14 French rubber catheters are inserted through stab wounds into the axilla and under the skin flaps. These are connected to a drainage bottle to which is applied a constant negative pressure of 15 cm. H_2O. Serosanguineous drainage (usually 200 ml. to 300 ml. per day) collects in the drainage bottle. The 15 cm. of positive atmospheric pressure acting against the skin flaps give a more continuous and uniform pressure than can be achieved with any type of mechanical dressing. The transparent plastic over the incision permits continuous observation of the wound. We have found that this dressing

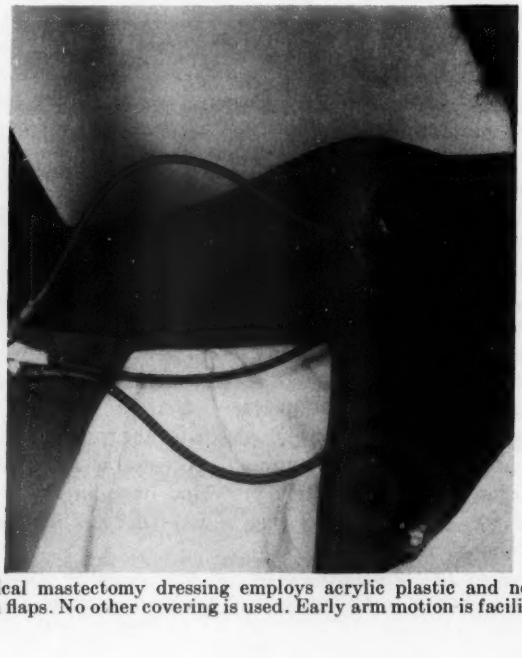

FIG. 1. Radical mastectomy dressing employs acrylic plastic and negative pressure drainage of skin flaps. No other covering is used. Early arm motion is facilitated.

is more comfortable and esthetically pleasing to the patient, permits early detection of loss of skin flap viability, and is accompanied by a decreased incidence of fluid collection under the skin flaps. In those patients requiring split-thickness skin graft, the negative pressure drainage is used, but the usual stent-type dressing is employed instead of acrylic plastic.

OPERATIVE FIELD PREPARATION

The usual skin preparation of the operative field employed in this clinic consists of a vigorous mechanical scrub with ether soaked sponges, followed by a similar scrub with an alcoholic solution of benzalkonium chloride. The efficacy of this preparation was tested by depositing 2 cc. of sterile saline solution on the surface of the prepared skin, and then making a blood agar pour plate with the reaspirated fluid. Colony counts of these deep pour blood agar plates were then made at the end of 24 hours. The described skin preparation was found satisfactory since only an occasional culture showed bacterial growth (1 to 9 colonies).

On the other hand, this skin preparation was found to be unreliable in the presence of gross contamination from a draining wound on the abdomen. Bacteriologic studies were carried out in 6 candidates for laparotomy who had previously had an abdominal colostomy performed. After the routine skin preparation, gross bacterial contamination of the skin in the operative area remained. The plastic spray was employed, therefore, to create a sterile operative field by spraying the surface of the skin after the usual preoperative preparation. The culture technic was modified as follows:

The usual skin preparation was done and a surface culture was taken as described above. The operative area was then covered with the plastic spray, and a second culture was taken from the surface of the dried plastic. At the end of the operative procedure, a third culture was taken from the surface of the plastic. The plastic was then removed by peeling up an edge, and a fourth culture was taken from the underlying skin surface.

The results of this technic in one of the patients are presented in figure 2. The first and fourth cultures, taken from the surface of the skin before and after the operative procedure each showed 240 colonies of mixed bacteria per plate. Cultures taken from the surface of the plastic both before and after the operative procedure were sterile. Although the plastic film did not sterilize the underlying skin, it is apparent that it accomplished a mechanical fixation of the bacteria to the skin and prevented their introduction into the freshly incised wound. On the basis of these studies, this technic of plastic preparation of the operative field is now employed routinely in grossly contaminated cases.

Bailey[1] has suggested cutting the rubber glove from the index finger when performing intracardiac surgery since the improved tactile sensation is more important than the danger of infection introduced by this maneuver. We have regularly employed this technic although the fear of bacterial endocarditis is a major deterrent to its use. We have recently employed the acrylic plastic to give a sterile cover to the index finger from which the rubber glove has been

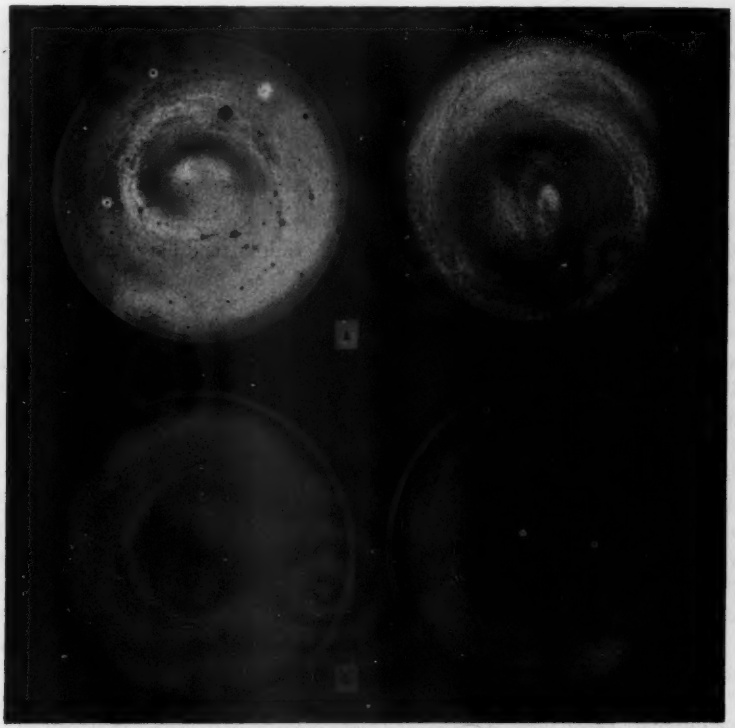

FIG. 2. Blood Agar Plates. *Left upper:* After routine skin preparation, contamination is heavy. *Right upper, left lower:* Surface of plastic is sterile before and after operation. *Right lower:* Skin surface under plastic shows bacterial growth at end of operation. See text.

removed. Tactile sense is not altered by the presence of the plastic film and the liklihood of introducing infection is minimized.

SKIN PROTECTANT

One of the most difficult dressing problems in the realm of clinical surgery concerns the care of the abdominal skin surrounding the site of high intestinal and pancreatic fistulas. The proteolytic enzymes in the escaping intestinal juices first excoriate and then digest the skin about the wound. Ileostomy paste and aluminum paste give only partial protection. They must be applied frequently, and are esthetically unpleasing. The use of absorbent dressings over such fistulas aggravates the autodigestion of the skin by keeping the proteolytic enzymes in contact with the skin in a state of optimum moisture and warmth.

Our previous attempts to use a vinyl plastic as a skin protectant proved unsatisfactory. The intestinal juices dissected between the plastic film and the skin and were thus held in constant contact with the body surfaces by the over-

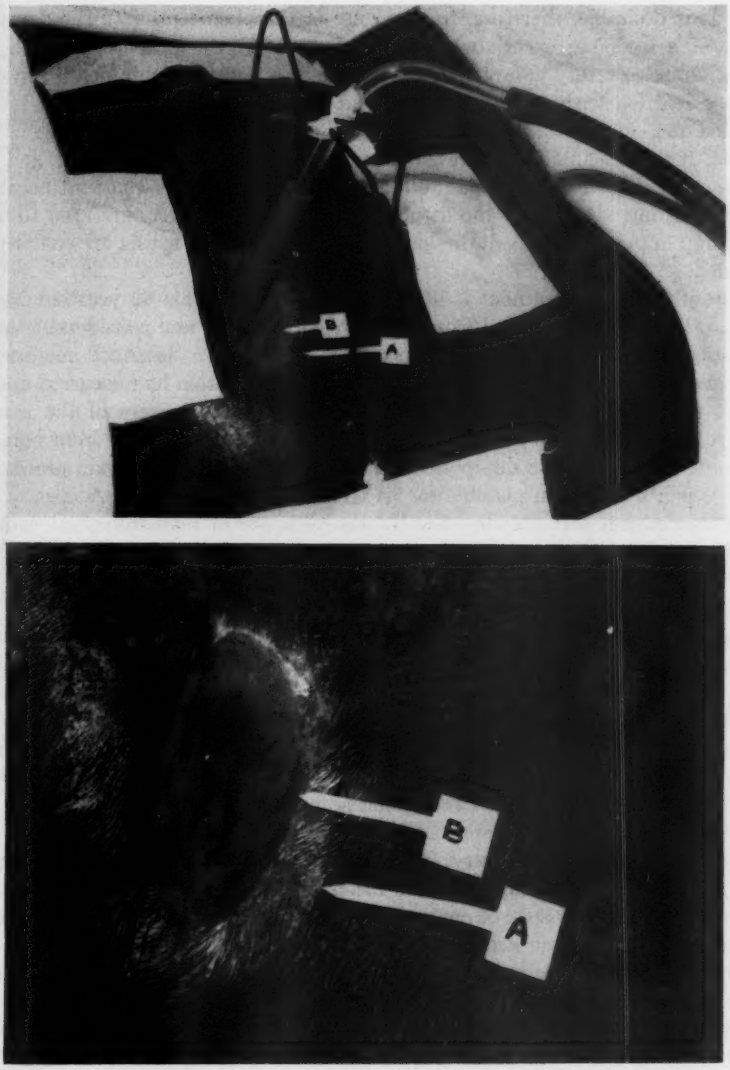

FIG. 3. *Top:* A negative pressure sump drain is inserted in high intestinal fistula. Bent wire coat hangers hold drain in place. Only dressing is plastic skin protectant. *Bottom:* Within 8 days, new unpigmented epithelium has grown underneath plastic film to edge of fistula (point A to point B).

lying intact plastic. Acrylic plastics employed in these experiments proved a satisfactory answer to this problem.

There are several important features in their application. The skin surrounding the fistula must be absolutely dry at the time of application of the plastic

film. It is desirable, therefore, to begin use of the plastic prior to the development of a weeping, excoriated dermatitis. Even in the presence of such excoriation, satisfactory adhesion of the acrylic plastic can be obtained if the skin surface is dried with ether prior to the application. The wound should be inspected at regular intervals to detect loosening of the plastic at the edge of the fistula. If such occurs, the entire film should be removed, the skin dried, and the plastic reapplied. A sump type drain attached to a source of constant negative pressure is introduced into the fistula. Bent wire coat hangers are used to hold the sump in place. Absorbent dressings in the region of the fistula are completely avoided.

A result of this treatment is illustrated in figure 3. This 60 year old Negro woman had a high intestinal fistula of 3 weeks duration and considerable autodigestion around the wound had occurred. The above described method of treatment was initiated and within 8 days re-epithelization had occurred underneath the plastic film and had progressed to the very margin of the fistula. Figure 3 illustrates the growth of new, unpigmented, epithelium from point A to point B during this 8 day period. This is the only method of skin protection with which it has been possible for us to avoid completely all evidence of cutaneous reaction and autodigestion in the presence of high intestinal or pancreatic fistulas.

DISCUSSION

Because the acrylic plastic described in these studies is not commercially available in the United States, we have been unable to determine the relative cost of this dressing and the standard gauze dressing. Rigler and Adams[11] calculate that a vinyl plastic dressing is at least as cheap as the conventional dressing. There are several minor disadvantages to the use of the plastic dressing for routine clean wounds. If hemostasis at the end of operation is not complete, small droplets of blood may collect under the rapidly drying plastic. In some instances these droplets may cause soiling of hospital linen in the first 10 to 15 minutes after surgery. The removal of sutures requires dissolving of the plastic film and is slightly more inconvenient than with the conventional dressing. Perhaps because of convention, more than for these reasons, we have continued to use gauze dressings for routine clean operative wounds. On the other hand, the acrylic dressing has been incomparably superior in those specific applications outlined in this report.

Choy and Wendt[4] have emphasized the potential value of plastic dressings in the treatment of mass burn casualties resulting from nuclear warfare. Prior to the present study, the vinyl plastic described by these investigators was employed in a series of 19 clinical burn patients. Although the plastic dressing was economical and easy to use, it was unsatisfactory when bleb formation was present. It failed to prevent increase in bleb size and in these instances the plastic film often cracked allowing organisms to enter the wounds. On the basis of this experience, no attempt was made to evaluate completely the acrylic plastic as a burn dressing. A definitive conclusion regarding the use of this plastic as a burn dressing awaits further clinical observations.

SUMMARY

The surgical uses of an acrylic resin plastic as a wound dressing, skin protectant, and operative field preparation are described. The plastic serves as a satisfactory wound dressing for routine operative incisions. It is of particular value in the protection of fresh incisions from neighboring sources of contamination. Bacteriologic studies indicate that it can be used as an operative field preparation to give a completely sterile skin surface in those situations where the routine antiseptic skin preparation is inadequate. It is of unique value as a skin protectant in the presence of high intestinal or pancreatic fistulas.

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EDITORIAL

PROPHYLACTIC OOPHORECTOMY IN TREATMENT OF CANCER OF THE BREAST

The only new development in the treatment of cancer of the breast during the past 20 years has been the addition of hormone therapy. The use of both male and female hormones in the treatment of advanced cancer is accepted and universally used, however the prophylactic use of hormones has been slowly adopted and even severely criticised.

We know that if metastases to the bones are discovered several years after an operation for cancer of the breast and there is no local recurrence either to the skin or the axilla, the metastases to the bones were probably there at the time of operation but were so small they produced no symptoms and could not be detected by roentgenologic or other studies. However, they were there as minute embolic transplants. We also know that when large and obviously apparent metastases are present, the administration of, or removal of one of the sex hormones will, in the majority of patients, cause atrophy and frequently temporary disappearance by roentgenologic evidence of these metastatic growths. If this disturbance of the hormone balance can produce these remarkable results in the larger metastases, we have every reason to believe that the same process will occur in the smaller or even microscopic metastases and cause them to either completely disappear or so disturb their metabolism that they will remain quiescent for a long period.

Shimkin stated that, "Mammary tumors occurred more frequently in breeding than in nonbreeding mice. In some strains, the incidence of tumors is proportional to the number of pregnancies undergone by the mice. Loeb further demonstrated that the incidence of tumors can be radically reduced by ovariectomy, and that the incidence is related to the age of the animal at the time of ovariectomy. Cori and W. S. Murray substantiated these findings, and the latter succeeded in obtaining mammary tumors in castrated male mice bearing ovarian grafts."

It was also determined that "the site, the growth, and the histologic appearance of mammary tumors elicited in mice injected with estrogens correspond in all details to the description of the spontaneous adenocarcinomas in female mice."

That the prognosis of carcinoma of the breast is worse in young women when ovarian function is most active has been rather generally accepted. Sittenfield stated: "Every cancer worker realizes that cancer of the breast in a woman under 40 years of age is a highly malignant disease and notwithstanding the most thorough surgical excision and large doses of radiant energy, the end results are very grave and disappointing."

The beneficial results of removing the ovaries along with a radical operation for cancer of the breast may be attributed to the withdrawal of a causal gene-

sis, to the removal of a formal genesis, or to a combination of both of these factors. The recurrences of cancer of the breast after a radical operation are doubtless due to cancer cells that have been left. The small amount that remains, however, would be stimulated by estrogenic substances. Removal of the estrogenic stimuli by surgical castration should produce longer survival periods.

Prophylactic oophorectomy was apparently first suggested by Schinzinger, although according to his article, he did not carry it out. He is said to have discussed this before the Surgical Congress in Berlin on April 25, 1899. Doubtless it has been performed by other surgeons, although there does not seem to be any available record of the number of cases or their follow-up.

Because of the very poor results he was obtaining from radical amputation of the breast in young women with cancer of the breast, and because of the interesting and stimulating work being done on hormones and their relation to breast cancer in experimental animals, in 1937 the late J. Shelton Horsley began castration as a prophylactic procedure in young women with this disease.

At first a bilateral oophorectomy was done with radical operation for cancer of the breast only on patients under 40 years of age. Later this was extended to all patients in the premenopausal stage. The desirability of having both ovaries removed along with the radical operation is, of course, first explained to the patient.

During the early period castration by x-ray was also tried on some of these patients, but this was not satisfactory because of the uncertainty of complete destruction of the ovarian function. It was believed that if the ovaries were to be rendered completely functionless, it was more effective to remove them surgically than to destroy their function by radiation. The results have been so satisfactory with castration at the time of primary operation that this method has been continued and has been extended to those patients who are up to 1 or 2 years postmenopausal.

Surgical removal of the ovaries in a patient who has not had previous abdominal operations or has no extensive pelvic pathology is an easy and simple procedure. It is done at the time of the mastectomy. While the assistant is closing the breast wound, the operator makes a short lower abdominal midline incision through which the ovaries are delivered, their ligaments clamped, the ovaries removed, and the pedicles sutured. This procedure usually can be completed before the breast operation has been finished.

One of the chief criticisms of prophylactic oophorectomy is the possible disturbance of the individual's sex pattern and the advent of menopausal symptoms. It is well known that menopause does not necessarily change libido or the sex pattern of the individual. We have closely followed these patients, and in not one case has there been any noticeable change in libido as far as the patient could discern. However, there have been menopausal symptoms, some very mild and others more severe, but all were satisfactorily controlled by mild sedation, with or without the use of progesterone or occasionally testosterone. In no patient have we resorted to any estrogenic substance.

We have a small series of cases which have been followed since 1937, and

the results are, we believe, worth noting. There are a total of 84 consecutive cases in which the patient was treated by castration at the time of radical surgery as a prophylactic measure, and of these 61 have been followed for 5 or more years. There is an 88 per cent or more year survival without any evidence of metastases in those patients with the cancer confined to the breast, and a 45 per cent 5 or more year survival in patients with axillary metastases, with an over-all 5 year survival of 67 per cent in all patients who have been castrated. These figures are better than the ones we have on our other cases of cancer of the breast, which are respectively 80 per cent without metastases and 36 per cent with metastases, and 59 per cent of all cases. The 10 and 15 year survival rate is also definitely better in the castrated than in the other patients.

Haagensen stated: "It is easy to attribute a share of the beneficial effects of hormone therapy in breast carcinoma to the general stimulative effects of these substances. But when severe pain owing to bone metastases is relieved, when carcinoma nodules in the skin disappear, when pleural fluid ceases to accumulate, and when metastatic masses in the liver decrease in size, we must postulate that there is to some degree a direct restraining effect by the hormone upon the growth of the carcinoma cells. We certainly do not know the mechanism of this restraining effect, but even though this growth inhibition is obtained in only a minority of the patients, the validity of the phenomenon gives hope that an explanation may be found for it."

More time must elapse and more cases followed before we can draw any final conclusion as to the value of this procedure. Just as hormone therapy and castration in the male has prolonged the survival rate in patients with carcinoma of the prostate, castration in the female with carcinoma of the breast has prolonged the survival rate in our small series of cases. This is an adjunct procedure and certainly deserves further study and consideration.

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BOOK REVIEWS

The editors of THE AMERICAN SURGEON *will at all times welcome new books in the field of surgery and will acknowledge their receipt in these pages. The editors do not, however, agree to review all books that have been submitted without solicitation.*

Anatomical Techniques. By D. H. TOMPSETT, E. E. & S. Livingstone, Ltd., Edinburgh.

This is a well written book by the Prosector to the Royal College of Surgeons of England. It presents many diagrams, excellent photographs, and a "do it yourself" text for the preparation of anatomical specimens as museum pieces. Many formulas for preservatives and other compounds are given. As stated in the Foreword, this book is intended for use primarily by the anatomist and the curator. This reviewer found the text interesting.

ROGER D. SCOTT, M.D.

Operative Surgery, Vol. 2. By CHARLES ROB AND RODNEY SMITH, Butterworth and Co., London.

Twenty-two British surgeons contribute to make this volume an outstanding operative surgery atlas-text. It is divided into 64 major topics with indications, contraindications, preparation, anesthesia, position, postoperative care and complications concisely, and effectively, described. Special contraindications and special equipment are also given in some instances. The major portion of the book is devoted to *The Operation*. This is well presented in a step by step manner with an adequate description occupying one half of the page and illustrations for each step occupying the other half of the page. The manner of presentation is a distinct advantage in allowing this book to be easily read. *The Operation* section includes various procedures, including newer ones, for each clinical entity covered. The many topics give a broad coverage of abdominal surgery. The illustrations prepared by various artists are profuse and excellent except that in a few instances the illustrations are too small for visualization of the finer details.

This reviewer believes this to be the best and most complete text presently available on operative surgery. It is highly recommended for use by the skilled as well as the novice surgeon.

ROGER D. SCOTT, M.D.

BOOKS RECEIVED

Books received are acknowledged in this section, and such acknowledgement must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

You and Your Operation. By BENJAMIN R. REITER, M.D., New York City, The Macmillan Company.

Wire Brush Surgery. By JAMES, W. BURKS, JR., M.S., M.D., Springfield, Illinois, Charles C Thomas Company.

Manual of Recovery Room Care. By JOHN M. BEAL, M.D., New York City, The Macmillan Company.